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A SYNOPSIS OF THE *APHIDIDAE* OF CALIFORNIA*

BY

ALBERT F. SWAIN

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* Paper no. 51, University of California, Graduate School of Tropical Agriculture and Citrus Experiment Station, Riverside, California. Manuscript submitted for publication May 20, 1918.

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INTRODUCTION

In recent years considerable attention has been paid to the Aphididae in the United States, and in Europe as well, and a large amount of literature is the result. In California, W. T. Clarke was the first to make any systematic studies of these insects and his paper, published in 1903, embodies the results of these studies. He listed forty-three species, ten of which were described as new. Two or three of his new species are known at present, but the remainder are unknown. Unfortunately his collection was destroyed in the earthquake of April, 1906, so now it is practically impossible to determine his new species with any degree of accuracy. Following this, there was a period of six years in which there were no publications concerning the Aphididae of California, except some economic bulletins from the Experiment Station. In 1909, both E. O. Essig and W. M. Davidson published the results of their earlier studies. Since then both have added papers occasionally. During 1912 and shortly before, Harold Morrison made an extensive study of the species in the vicinity of Stanford University. He has kindly placed a report of his studies in the author's hands, with permission to publish the records in this paper. The author has been studying the Californian species continuously since 1914.

At present there are about one hundred and eighty species known to occur in California. This number will undoubtedly be greatly increased as further studies are made, since to date only a comparatively small part of the state has been covered by collectors. Very extensive collections have been made in Ventura County and in the vicinity of Pomona College, Los Angeles County, by Essig. The San Francisco Bay region, particularly in the vicinity of the University of California and Stanford University, has been carefully surveyed for aphids, collections having been made by Clarke, Davidson, Essig, Morrison, Ferris, and the author. Davidson, Clarke, and Essig have made a few observations in the Sacramento Valley, particularly in Placer and Sacramento counties. The author made a number of observations in the vicinity of Fresno during May and June, 1915, and more or less extensive observations and collections during 1916 and 1917 in San Diego, Riverside, Orange, Los Angeles, and San Bernardino counties. In addition to these, reports come to the College of Agriculture occasionally from the State Insectary and the various county horticultural commissioners. A summary of the above statements shows that extensive collecting has been done only in the territory adjacent to San Francisco Bay, and throughout southern California. The whole northern half of the state, the great interior valleys of the Sacramento and San Joaquin rivers, and the desert sections of the southeastern part of the state are as yet unexplored. Undoubtedly many interesting species will be found in these parts.

The author wishes to express his appreciation of the aid rendered by various people during the past three years of study. To Harold Morrison of the Federal Board of Horticulture is due especial thanks for his assistance during the early part of the author's study, for his collection notes, and for the use of his extensive collections of Stanford University vicinity and Indiana; to E. O. Essig of the University of California for his continuous advice and assistance, for the use of his large collections of Californian species, and for the reading of this manuscript; to W. M. Davidson of the Bureau of Entomology, U. S. Department of Agriculture, for his many notes and determinations and for the use of his collection; to A. C. Baker, J. J. Davis, C. P. Gillette, A. S. Maxson, E. M. Patch, and H. F. Wilson for their many determinations and suggestions; to R. W. Doane of Stanford University for the permission to work over his collection of Utah aphids and for permitting his students to use the keys included in this paper, thereby finding the weak points in the keys; and finally to G. F. Ferris of Stanford University for collections and advice.

In this paper the author has brought together all the present records of California Aphididae. He has included keys for the determination of the subfamilies, groups, genera, and species, together with such illustrations as are necessary for an understanding of the keys. The discussion of each species includes a bibliography of the California literature (exclusive of the merely economic and popular), together with a citation of the original description and the best available description, a list of host plants and localities, and a discussion of the synonomy, life history, and habits so far as they are known. The descriptions of certain species are not readily accessible and of others not at all adequate. Such species have been redescribed by the author in so far as it was possible to obtain specimens. Incidentally it may be stated that the author has personally collected by far the larger number of the species recorded in this paper. In other cases the fact is noted. A host plant index (appendix 2) is also included.

The system of classification followed is the one most generally accepted by American aphidologists at the present time. The keys to the species have been formulated by the author, those to the genera and higher groups have to a large extent been adapted from other workers, particularly Wilson and Essig (Aphidinae), Börner (Phylloxerinae), and Tullgren (Pemphiginae). The papers of Baker, Clarke, Davidson, Davis, Essig, Gillette, Oestlund, Patch, Pergande, Williams, Wilson, and other American aphidologists have been found invaluable. Of the works of the European aphidologists, those of Börner, Buckton, Del Guercio, Koch, Mordwilko, Tullgren, and Van der Goot have been in constant use. The classification suggested by Van der Goot ("Zur Systematik der Aphiden," in *Tijdschrift voor Entomologie,* vol. 56, p. 1913) has proved interesting, and although the author has not felt at liberty to accept it in full, a translation of his keys to the groups and genera has been included herewith (appendix 1), which, it is hoped, will be of assistance in the making of determinations.

CLASSIFICATION

The Aphididae belong to the order Homoptera, being closely related to the Psyllidae, or jumping plant lice, the Aleyrodidae, or white flies, and the Coccidae, or scale insects. The Aphididae, or plant lice, are small, soft-bodied insects, ranging from less than one to five or six millimeters in length. Typically there are four forms: the apterous and the alate viviparous females, and the sexual forms, the oviparous females and the males. There is considerable variation from the above in different groups and species, as will be pointed out under the discussions of the various species. The alate viviparous females are the individuals most commonly taken by the collector and the ones that usually show the best characters for determinations. In the keys in this paper all characters refer to the alate viviparous females (the *alates*) unless otherwise mentioned.

EXTERNAL ANATOMY

The body[1] consists typically of three divisions, the head, thorax, and abdomen. In the apterous forms the mesothorax and metathorax are closely fused with the abdomen, while the prothorax and head are distinct. In the alate forms the mesothorax and metathorax are fused together and appear as a distinct division, the body appearing to consist of four divisions, viz., the head, the prothorax, the mesothorax and metathorax, and the abdomen.

The head bears a pair of compound eyes, usually three ocelli, a pair of three to six jointed antennae, and the beak. Of these, the antennae show the best characters for determinations, not only of species but of higher groups. They are either mounted on distinct tubercles (Macrosiphini, certain Callipterini) or appear to arise from the front of the head. They consist of from three to six segments, the terminal one of which is usually provided with a projection or spur. They are six-segmented in the Aphidinae (except Essigella and Cerosipha), five- or six-segmented in the Pemphiginae (except in the stem mothers of certain genera), and three-segmented in the Phylloxerinae (except in Chermisina, in which the alate forms have five-segmented and the sexual forms four-segmented antennae). The spur of the terminal segment may be equal to or longer than the segment (Aphidinae, in the Macrosiphini it attains its greatest length, often being as much as ten times the length of the base); it may be merely a short thumblike process (Pemphiginae, Lachnini, and certain Callipterini) · or it may be apparently lacking (Phylloxerinae). The two basal segments are always short, and quite regular in all species. The remaining segments show the greatest diversity, particularly in number, size, and shape. Sensoria are always present on some of the segments. There is one primary sensorium always present at the distal end of the terminal segment, and when the antennae consist of more than three segments, one also at the distal end of the penultimate segment. These sensoria are fairly large and clear (sometimes furnished with a hairy fringe) and are more or less circular. The accessory sensoria are a group of small indistinct sensoria, which number from three to six, and which are located in close proximity

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[1] For a fuller discussion of the external characters consult the following papers: Vickerey, R. A., A comparative study of the external anatomy of plant lice, 12th Rept. Minnesota State Entomologist 1908; Sanborn, C. E., Kansas Aphididae, Kansas Univ. Sci. Bull., vol. 3, 1904; Mordwilko, Alexander, Keys to the groups and genera of the Aphididae, Ann. Mus. Zool. Imp. Acad. Sci. St. Petersburg, vol. 13, pp. 362–364, 1908.

to the primary sensorium on the terminal segment. Secondary sensoria are usually present in the alate forms, but oftentimes absent in the apterae of certain species. When present they are always on the third segment, but in antennae consisting of five or six segments, they may be present upon the fourth, fifth, and even sixth segments. In the Pemphiginae they are arch-like or half rings, or form complete rings about the segments. In the Aphidinae they are circular, oval, or transversely linear, but are never rings or half rings. The shape and number vary considerably, and are of specific importance. The number may vary from as few as three or four (*Myzocallis maureri* Swain), to as many as forty to fifty on the third segment, and many also on the fourth and fifth (*Myzus braggii* Gillette). Unfortunately these highly important characters were overlooked or not taken into consideration by the earlier workers. The beak is four-jointed and seems to arise from between the fore legs. It is always present (except in the sexes of certain of the Phylloxerinae), but is seldom of specific importance (except to distinguish *Aphis bakeri* Cowen from *Aphis senecio* Swain, and in certain of the Lachini). It may be very short, as in *Aphis bakeri* Cowen, where it reaches only slightly beyond the first coxa, or it may be very long as in *Stomaphis*, where it is from one and one-half to two times as long as the body. In leaf-feeding species it is usually short, while in bark-feeding forms it is longer. This is naturally necessary, for those that live on thick bark must have a longer beak in order to reach through to the plant juices.

The thorax consists of three divisions, the last two of which are usually more or less fused together, and considered as one; the two divisions being called, in this paper, the prothorax and the thorax. On the lateral margins of the prothorax there is sometimes a pair of small tubercles. These are not present in all species, however, and they differ considerably in size in the various species. There are three pairs of fairly long and slender legs (except in Phylloxerinae. where the legs are greatly atrophied, approaching those of the Coccinae in size). Typically the legs consist of four joints, the coxa, the femora, the tibia, and the tarsus. In some genera the tarsi may be atrophied (*Atarsos, Mastapoda*). The comparative lengths of the first and second segment of the tarsi are sometimes of generic importance (Lachnini), and the comparative lengths of the hind tarsi and the cornicles are oftentimes of specific importance (*Aphis, Pterocomma*). A small empodial hair is found between the claws in the Aphidinae. In the Callipterina it is leaf-shaped or spatula-like. In the Aphidina and Lachnina it is hair-like, usually being as long as the claws (except in the Pterocommini, in which it is considerably shorter than the claws). The wings are membraneous and hyaline (except in certain Callipterini, Lachnini, and Macrosiphini), and are held roof-like over the body when at rest (except *Monellia,* Phylloxerinae, Hormaphidina, in which they lie flat on the abdomen). The veins of the fore wings are as follows: the costal and subcostal are almost parallel with the anterior margin; the radial extends from the posterior margin of the stigma to the outer margin of the wing, being either curved or straight; the discoidals, three in number, extend from the subcostal to the posterior margin of the wing. The outer or third discoidal (*media, cubitus* of some authors) may be simple (Hormaphidina, Pemphigina), absent (Phylloxerinae), once-branched (Schizoneurina), or twice-branched (Aphidinae, except *Toxoptera*). On the anterior margin of the fore wing is a dusky spot located between the wing margin and the subcostal veins, and between the distal ends of the costal and subcostal veins, known as the stigma or Pterostigma. It is usually trapezoidal in shape, and does not extend to the tip of the wing (except in *Longistigma* and *Mindarus,* in which it reaches well beyond the tip of the wing). The hind wings have one longitudinal and either one or two transverse veins.[2] In the Pemphiginae and Phylloxerinae dorsal wax glands are sometimes present on the thorax, in which case their number, shape, and position are of more or less specific importance.

The abdomen consists of nine more or less similar segments. The coloration of the various segments, especially in species in which the color is variegated, is sometimes of specific importance. In certain species wax glands are present on the abdomen (Phylloxerinae, and particularly the stem mothers of Pemphiginae) and may be of use in making determinations. In the Aphidinae the presence or absence and location of small lateral and dorsal tubercles are often important. The anal segment consists of an anal plate and a cauda. The cauda may not be separated from the abdomen (Pemphiginae, Lachnina), or it may be short and conical (Aphidini), short and globular, being constricted in the middle (Callipterina), or it may be long and ensiform or sickle-shaped (Macrosiphini). The anal plate is usually well rounded, being half-moon-shaped, or it may be emarginate or bilobed (Callipterina). On the sixth (or fifth?) segment is a pair of short tubular processes, the cornicles (honey tubes, nectaries of some authors). These are quite valuable characters, both specific and generic. In the Phylloxerinae and most of the Pemphiginae they are lacking, but in the Aphidinae they are always present, and show a great diversity of form. They may be merely pores (certain Callipterini, *Cerosipha cupressi* Swain, *Lachnus taxifolia* Swain), they may be cylindrical, yet quite short (certain Callipterini, Chaitophorini); they may be short and cylindrical or conical (Aphidini); they may be truncate, cone-shape (Lachnini); they may be clavate and long (certain Callipterina, Pterocommini, Macrosiphini); or they may be long and cylindrical (particularly in *Macrosiphum* and *Myzus*).

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[2] For a full discussion of the venation see Patch, Edith M., Homologies of the wing veins of the Aphididae, Psyllidae, Aleurodidae, and Coccidae, Ann. Entom. Soc. Am., vol. 2, pp. 101–136, June, 1909.

BIOLOGY

Considerable variety is exhibited in the habits, life history, and methods of reproduction, as well as in the structure and body form. Reproduction is almost entirely parthenogenetic, although certain species at certain times have a sexual reproduction. Fewer species have sexual reproduction in California than in colder climates, due to the fact that mild weather throughout the winter permits them to live over, and hence the eggs are unnecessary. Many species produce generation after generation parthenogenetically, and are most abundant in the spring and early summer, but gradually disappear toward midsummer, due partially to their predaceous and parasitic enemies, and partially, undoubtedly, to the heat of the summer. Other species regularly produce sexual forms in the fall, which lay eggs that hatch the next spring. The forms hatching from the eggs are wingless (except in Callipterini) and usually of a different form from the later generations, and are known as the fundatrix or stem mother. The fundatrix is always viviparous. Her progeny consists either of all apterous or partly apterous and partly alate viviparous females (fundatrigenia), which in turn produce other generations of fundatrigeniae. The last asexual generation in the fall, which gives birth to the sexual forms (sexuales), are known as sexupara, and are usually alate. Oftentimes in the second or third and even fourth generation there is a definite migration from one species of host plant to another, where the aphids live over the summer (virgogenia), the sexupara returning to the original species of host in the fall to give birth to the sexuales, which lay their eggs there. *Aphis malifoliae* Fitch represents an example of this habit, the winter host being apple, the summer plantain. Oftentimes the fall migrants (sexupara) of certain species differ considerably in structure from the spring migrants (fundatrigenia). This is particularly noticeable in the Pemphiginae. Many species are confined throughout the season to one species of host, others to one or two or a few species, while still others may live on any of a number of hosts (*Aphis senecio* Swain, *Rhopalosiphum persicae* (Sulz.)). All sustenance is derived from the plant juices of the various hosts, but each species is usually confined more or less definately to feeding on some certain part of the plant. Some live entirely upon the leaves, some on the stems of the leaves and small twigs, some on the trunks and larger branches, some on the roots, some on the flower heads and racemes of the host, and still others feed on almost any part of the plant. The greater number of species are free living, but certain of the Aphidinae form pseudogalls (*Aphis pomi* De Geer, *Aphis malifoliae* Fitch, *Phyllaphis coweni* (Cockerell)), while the Pemphiginae and Chermisina form true galls. Nearly all of the Pemphigina spend at least part of the season on various species of *Populus*, the Schizoneurina on *Ulmus*, while the Lachnini and Chermisina are practically confined to the conifers. The Aphidinae are found mostly on deciduous trees and herbaceous plants, although some live on conifers (*Myzaphis abietinus* (Walker), *Nectarosiphon morrisoni* Swain).

ECONOMIC CONSIDERATIONS

From an economic standpoint most of the species are of no importance, although there are many that are well known pests of cultivated crops. For example the woolly apple aphis (*Eriosoma lanigera*) is a world-wide pest of considerable importance to the apple. The green and the rosy apple aphis (*Aphis pomi, A. malifoliae*) do a large amount of injury in certain localities, and are extremely difficult to control. The rose aphis (*Macrosiphum rosae*) is known the world over, and although living unprotected and easily killed with any of the common contact insecticides, it is recognized by everyone who has grown roses in the dooryard as an extremely troublesome pest. The walnut aphis (*Chromaphis juglandicola*), the cabbage aphis (*Aphis brassicae*), the green peach aphis or greenhouse aphis (*Rhopalosiphum persicae*) are all well known pests. The common contact insecticides are usually efficient for their control. Many species are kept well in check by their predaceous and parasitic enemies, the ladybirds, the syrphid flies, the lacewings, and the braconids. Of the ladybirds, probably the most efficient in California are *Coccinella californica*

Mann., *Hippodamia convergens* Guerin, and *Scymnus nebulosus* Leconte. Of the syrphid flies, those consuming the largest number of aphids and the most abundant in the state[3] are *Catabomba pyrastri* Osten-Sacken, *Allograpta obliqua* Say, *Syrphus arcuatus* Fallen, *S. americanus* Wied., *S. opinator* Will., and *Eupeodes volucris* Osten-Sacken. *Chrysopa californica* Coq. and *Sympherobius angustus* Banks are the most important aphid enemies among the lacewings. Among the Braconidae there are two very common species in California, *Lysiphlebus testaceipes* Cresson and *Diaretus rapae* Curtiss. Others have been reared by the author and will be mentioned later. The author wishes to thank Dr. L. O. Howard and Mr. A. B. Gahan of the Bureau of Entomology for their kindness in identifying the various hymenopterous parasites of aphids sent to them.

SYNOPSIS

Family **Aphididae** Passerini

Passerini, Gli Afidi, 1860.

The family Aphididae Passerini is divided into three subfamilies (following Alexander Mordwilko), which are: Aphidinae Buckton, Pemphiginae Mordwilko, and Phylloxerinae Dreyfus. Van der Goot considers but two subfamilies: Aphidinae v. d. G. and Chermisinae v. d. G. His subfamily Aphidinae includes both the Aphidinae and Pemphiginae of Mordwilko, while his Chermisinae is the same as Mordwilko's Phylloxerinae. Following is a translation of Van der Goot's descriptions of the two subfamilies:

Subfamily *Aphidinae* v. d. G.: Body very often without distinct groups of glands for the secretion of wax. Antennae usually six- or seven-jointed [when the terminal process of the sixth segment is longer than the segment he considers it as the seventh segment]. Only in a few cases are the apterous forms with three-segmented antennae. The primary sensoria usually have a distinct ''haarkranz'' [hairy fringe?]. Cornicles almost always and cauda often present. Fore wings with four veins, the cubitus or media I very often divided: hind wings usually with two cross-veins. Vivi-oviparous: the sexuales mostly of the usual form.

Subfamily *Chermisinae* v. d. G.: Body almost always with distinct groups of glands for the production of wax. Antennae three-segmented, often evidently five-segmented. Sensoria always without ''haarkranz.'' Cornicles always absent. Fore wings with three veins; hind wings with only one small vein. Always only oviparous: sexuales dwarfish, with or without beak.

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[3] Davidson, W. M., Syrphidae in California, Jour. Econ. Ent., vol. 9, pp. 454–457, 1916.

The latter subfamily has been considered by the author as Phylloxerinae Dreyfus; the former as two subfamilies, Aphidinae Buckton and Pemphiginae Mordwilko. Mordwilko gives the following characters for these two subfamilies:

> Subfamily *Pemphiginae* Mordw.: Antennae of the alate forms five- or six-segmented, the third bearing a specifically definite number of transverse or arch-like sensoria; short, usually not longer than the head and thorax. The apterous parthenogenetic females have four- to six-segmented antennae, but these are sometimes reduced to three or even to two segments. The fore wings of the alate forms have four transverse veins, of which the third or cubital vein [third discoidal] is either simple or once-branched. The hind wings have one or two transverse veins. The cornicles are either entirely absent or very slightly developed, and in the latter case may not be present in all the forms of one species.
>
> Subfamily *Aphidinae* Buckton: Antennae always six-segmented, except in the stem mother of some species, and in the genus *Sipha* Passerini. [This genus is not represented in California. In *Essigella* Del Guercio, *Cerosipha* Del Guercio, and *Trifidaphis* Del Guercio, three Californian genera described since the publication of Mordwilko's paper, the antennae are but five-segmented.] The last antennal segment often ends in a long thread-like filament which may be longer than the segment. Antennae with a long filament are mostly from half the length of the body to longer than the body. The antennal filament is characteristic only for this subfamily; some genera of the groups *Lachnina* and *Callipterina* have a very short filament, and the antennae are not longer than the head and thorax. The sensoria are small and are shaped like dots, circles, or transverse holes, but never archlike or half-rings. Segment 3 bears the largest number, especially in the alate forms. The cubitus [third discoidal] of the fore wings is usually twice-branched although there are some exceptions, as *Toxoptera* Koch. Most species have long cylindrical cornicles which are often clavate in the middle. Sometimes they may be greatly reduced or poorly developed, and, as in *Lachnina* and *Callipterina*, they may be replaced by cupola-shaped elevations. A cauda is usually present, being conicle, ensiform, or globular, although in *Lachnina* it is not evident. The sexual forms have beaks, and become quite large.

Subfamily **Aphidinae** Buckton

Buckton, Mono, British Aphides, 1883.

This subfamily is divided into three groups, following Carl Börner (Sorauer, Paul, Handbuch der Pflanzenkrankheiten, vol. 3, p. 664, 1913). Börner considers the family Aphididae as a superfamily, and divides it into four families; so this subfamily Aphidinae he considers a family, and the various groups as subfamilies. Below is a translation of his key:

1. Claws with spatula-like or leaf-shaped empodial hairs (fig. 1). Cornicles variously formed, bare. Pubescence of larvae as in Aphidina. The majority of the species live free and monophagous on trees, only seldom on herbaceous plants, and never migrate collectively ....Group **Callipterina**

— Claws with simple empodial hairs (fig. 2), often hard to see 2

2. Antennae with short terminal joint (fig. 3), (except in Pterocommini, but then the cauda is not tail-like). Body ridges with more than six longitudinal rows of hairs. Hairy covering mostly thick. Cauda not lengthened tail-like, anal plate widely rounded (fig. 5). Wax glands either present or lacking. Mostly strongly monophagous forms, at times of remarkable size. Found mostly on tree growths and without change of hosts ....Group **Lachnina**

— Terminal joint of antennae always with a long, slender filamentous projection (fig. 4). Body ridges of young larvae at most with only six longitudinal rows of hairs, which may be increased after the first molt. Cauda either short or lengthened tail-like, anal plate widely rounded (fig. 6). Species monophagous or polyphagous, many with a change of host plants. On tree or herbaceous growths ....Group **Aphidina**

Group **Callipterina** Mord

(Subfamily **Callipterinae** Börner)

Mordwilko, Ann. Imperial Acad. Sci., St. Petersb., 1908.
Börner, *in* Sorauer, Handbuch der Pflanzenkrankheiten, vol. 3, p. 664, 1913.

According to Börner this group consists of two tribes, the Phyllaphidini and the Callipterini. He divides the Callipterini into two groups, the Callipterini and the Chaitophori. The author has followed him to a certain extent, but has given each of the last two groups equal rank with the Phyllaphidini, and thus considers this group, Callipterina, as consisting of three tribes. Below is a key to the same:

1. Wax glands with faceted pore fields present. Antennae as in Lachnina (fig. 13). Pubescence delicate .... Tribe **Phyllaphidini**

— Wax glands lacking or without faceted pore fields. Pubescence often very remarkable. Terminal joint of the antennae often lengthened into a bristle (fig. 30) 2

2. Anal plate more or less emarginate or bilobed (fig. 7), except in *Eucraphis* Koch ....Tribe **Callipterini**

— Anal plate widely truncate or rounded (fig. 8) ....Tribe **Chaitophorini**

Tribe **Phillaphidini** Börner

Börner, *in* Sorauer, Handbuch der Pflanzenkrankheiten, vol. 3, p. 664, 1913.

This tribe Phyllaphidini consists of but one genus, *Phyllaphis* Koch, which is represented in California by three species.

1. Genus **Phyllaphis** Koch

Koch, Die Pflanzenläuse, p. 248, 1857. Type *Aphis fagi* Linn.

KEY TO CALIFORNIA SPECIES

1. Alate viviparous females unknown. Wing venation of alate males similar to that of *Eriosoma* spp. (fig. 17). Forming pseudogalls on edges of leaves or living free in masses of white flocculence on leaves of *Quercus* spp. **quercicola Baker**

— **Alate viviparous females common. Venation normal, the third discoidal being twice-branched. Not on *Quercus* spp. 2**

2. Antennae short, stout, with oval transverse sensoria (fig. 13). Forming galls on *Arctostaphylos* spp. (and *Arbutus* spp.) ....coweni (Ckll.)

— **Antennae longer and narrower with circular sensoria (figs. 9, 14–17). Living under thick masses of white flocculence on *Fagus* spp. ....fagi (Linn.)**

1. **Phyllaphis coweni** (Ckll.)

Figure 13

Cockerell, Can. Ent., vol. 37, pp. 391–392. 1905. *Pemphigus* (orig. desc.).

Davidson, Jour. Econ. Ent., vol. 4, pp. 559, 1911. *Cryptosiphum tahoense* n.sp. (desc.).

Davidson, Jour. Econ. Ent., vol. 5, p. 404, 1912 (list).

Essig, Pom. Jour. Ent.'Zool., vol. 7, pp. 187–195, 1915 (desc.).

Records.—Arctostaphylos manzanita; Oakville, Napa County, February, 1913 (E. L. Brannigan); Mount Diablo, Contra Costa County (Davidson); Jasper Ridge, Santa Clara County, October, 1914 (E. A. Cornwell); Pine Hills, San Diego County, June, 1916.[4] *A. pumella, A. tomentosa,* Lake Tahoe, August, 1911 (Davidson): *A. glauca,* Alpine, San Diego County, June, 1916.

This species is found more or less abundantly throughout the state wherever its host plants occur. Essig (1915) states it is found throughout the Rocky, Sierra Nevada, and Coast Range mountains, being more abundant in the central and northern parts of the state. The author has found it to be extremely abundant in the Cuyamaca and Laguna mountains in the extreme southern part of the state. The insects can be found at any time of the year in the galls on manzanita although most abundantly in the early fall. Collections by the author in June showed that the stem mothers and young virgogeniae only were present. A few weeks later the alate females were abundant, while in August the sexuales begin to appear. However, the alate viviparous females have been found in October and in February. This species forms galls on the leaves, and flower and fruit stalks of its host. Usually there is but one gall to a leaf, although sometimes four or five may be found. When first formed these galls are concolorous with the leaves; but as they become older they turn more and more reddish in color, until when mature they are a very bright red.

2. **Phyllaphis fagi** (Linn.)

Figures 9 to 12

Linnaeus, Syst. Nat., vol. 2, p. 735, 1735. *Aphis* (orig. desc.).

Davidson, Jour. Econ. Ent., vol. 3, p. 376, 1910 (list).

Records.—*Fagus* sp., Palo Alto, 1910 (Davidson); *Fagus sylvatica,* Stanford University, April to May, 1915.

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[4] Records in which no collector's name is mentioned refer to collections made by the author.

This species has been taken only in the vicinity of Stanford University, where it infests copper beach (*Fagus sylvatica*). It may be easily recognized by the masses of whitish flocculence on the under side of the leaves. Each mass contains one individual, which is entirely hidden by it. In looking up the literature of this species the author found that there has been no description of it published in America, so below is included a brief description of specimens taken near Stanford University on April 28 and May 29, 1915.

Alate viviparous female.—Prevailing color dark green, covered with a whitish flocculence. This flocculence consists of wax threads as much as 3 mm. long. Head dusky, with frontal margin black. Eyes red. Antennae dusky, except II and basal one-third of III, which are pale. Beak pale with apex and joints dusky. Thorax dusky green with lobes black. Abdomen dark green with a row of black spots on each margin and about seven black transverse dorsal bands. Cornicles black. Cauda and anal plate concolorous with abdomen with distal margins slightly darker. First and second femora pale with apices only dusky; third femora dusky throughout. First tibiae pale with apex dusky; second and third dusky throughout. Tarsi black. Wings hyaline, stigma gray.

Head twice as wide as long, furnished with many small wax glands. Antennae reaching to the cornicles or to the base of the cauda, set on small tubercles (fig. 12). III is the longest segment, followed by IV, V, and VI. VI spur is merely a thumb-like projection (fig. 16). The usual primary and accessory sensoria are present on V and VI. Secondary sensoria are found only on III (fig. 9). These are fairly large, almost circular, and placed in a single row along the segment. They number from four to seven, five being the average. The beak is short, reaching but slightly beyond the first coxae. The wings are normal, with a twice-branched third discoidal. The cornicles are merely small pores. The cauda is short and knobbed, the anal plate emarginate or bilobed (fig. 11).

Measurements: Body length 2.0 to 2.4 mm., width 0.8 to 1.04 mm., antennae total 1.55 to 2.06 mm., III 0.591 to 0.77 mm., IV 0.34 to 0.47 mm., V 0.27 to 0.39 mm., VI 0.19 to 0.25 mm., cornicles (diameter) 0.05 mm.

Apterous viviparous female.—Prevailing color under flocculence pale yellowish green. Light brown markings as follows: two rows of four spots each across the prothorax, one large spot on each margin and one on the dorsum of the thorax, four spots on each abdominal segment, two dorsal and two marginal. Antennae pale except VI, apical two-thirds of V, and apical one-third of IV. Legs pale with light brown spots at joints; tarsi black. Cauda small and conicle, cornicles not evident.

Measurements: Body length 2.9 to 3.0 mm., width 0.96 to 1.2 mm., antennae total 1.26 mm., III 0.36 mm., IV 0.32 mm., V 0.204 mm., VI 0.205 mm.

3. **Phyllaphis quercicola** Baker

Figures 14 to 20

Clarke, Can. Ent., vol. 35, p. 248, 1903. *Schizoneura querci* (Fitch) (list).
Davidson, Jour. Econ. Ent., vol. 3, p. 374, 1910. *S. querci* (Fitch) (list).
Davidson, Pom. Jour. Ent., vol. 3, p. 398, 1911. *S. querci* (Fitch) (list).
Davis, Ent. News, vol. 22, p. 241, 1911. *Phyllaphis querci* (Fitch) (biblig.)
Davidson, Jour. Econ. Ent., vol. 7, p. 127, 1914. *P. querci* (Fitch) (note).
Gillette, Ent. News, vol. 25, p. 274, 1914. *Phyllaphis* sp. (list).
Baker, Ent. News, vol. 27, p. 362, 1916. *P. quercicola* n.n. for *P. querci* (Fitch) of Davis.

Records.—*Quercus agrifolia;* Placer, Contra Costa, Santa Clara counties (Davidson, Clarke); Stanford University, April, 1915; Berkeley, September, 1915; Wynola, San Diego County, June, 1916; Charter Oak, Los Angeles County, November, 1916. *Quercus lobata,* Stanford University (Davidson); *Q. wislizenii,* Placer County (Davidson); *Q. dumosa,* San Diego, August, 1915; *Quercus* sp., Spreckels, Monterey County, 1913 (Gillette).

This is a very common species of woolly aphis on the oaks, particularly the live oak, through southern and central California. According to Davidson (1914) the stem mothers occur in pseudogalls on the edges of the leaves. The second generation lice, when mature, leave these galls to live on the upper and lower surfaces of the leaves, unprotected except for their woolly covering. The sexes, apterous oviparous females and alate males, occur late in the fall. The viviparous generations are all apterous. The writer has observed the stem mothers as late as August in San Diego County, while he has found the viviparous females on the under side of the leaves as early as mid-June in Berkeley.

The identity of this species has never been definitely established. It was thought to be the species described by Fitch (Rept. Ins. N. Y., vol. 5, p. 804, 1859) as *Eriosoma querci,* but in 1916 Baker pointed out the identity of *Eriosoma querci* Fitch, proving it to be identical with a species of *Anoecia* found on *Cornus* and formerly considered to be *A. corni* Fab. Baker's decision is that the *Quercus-Cornus* species of the eastern United States is *Anoecia querci* (Fitch) and is distinct from our western one. In 1911 Davis described a species of woolly aphis from oak under the name of *Phyllaphis querci* (Fitch) stating that it is the same one as listed by Davidson. Baker proposes the name *Phyllaphis quercicola* for this species described by Davis. Consequently it is so listed in this paper. This species is not a typical *Phyllaphis*, but it fits that genus better than any other so is placed there provisionally. The figures (14–20) are from a specimen of alate male in the Davidson collection in Stanford University.

Tribe **Callipterini** Wilson

Wilson, Can. Ent., vol. 42, p. 253, 1910.

The genera included in this tribe differ somewhat as considered by various entomologists. Since Wilson has worked out the synonomy of the various genera very well he is followed in preference to some of the European authors, although there are some points in which he is mistaken. For instance, he places *Pterocallis* Passerini, *Callipteroides* Mordwilko, *Tuberculatus* Mordwilko, *Subcallipterus* Mordwilko, and *Therioaphis* Walker as synonyms of *Myzocallis* Passerini. In regard to this, he states, "In 1894 Mordwilko used *A. coryli* Goetze as the type of his genus *Callipteroides*, but as this species..." He is mistaken in this, for in the paper referred to, Mordwilko used *A. coryli* Goetze as the type of the genus *Myzocallis Passerini*, and in 1908 he gave as the type of *Callipteroides*, *Callipterus nigritarsus* Heyden (*betulae* Koch). If *nigritarsus* Heyden is a synonym of *betulae* Koch, as Mordwilko indicates, then *Callipteroides* is a synonym of *Euceraphis* Walker, for *C. betulae* Koch certainly falls into this genus, as described by Wilson himself. The key to the California genera below is adapted from Wilson's key (Can. Ent., vol. 42, pp. 253–254, 1910).

KEY TO CALIFORNIA GENERA OF CALLIPTERINI

1. Antennal tubercles prominent (fig. 21); antennae always exceedingly long... 2
— Antennal tubercles wanting or very small (fig. 22); antennae variable, sometimes shorter than the body 3
2. Cornicles very long and large (figs. 23–24) 4
— Cornicles very short and more or less constricted in the middle 5
— Cornicles little more than pores (fig. 25). Wings held horizontal at rest. **Monellia** Oestlund
3. Cornicles distinct, usually being longer than broad in the middle (fig. 26) 6
— Cornicles little more than pores, and broader than long (fig. 25). Wings held horizontal at rest .... **Monellia** Oestlund

4. Cornicles one-fourth the length of the body or more, swollen in the middle (fig. 24) .... **Drepanosiphum** Koch

— Cornicles large and nearly one-fourth the length of the body, swollen at the base and tapering toward the middle (fig. 23) .... **Drepanaphis** Del Guercio

5. Inner side of antennal tubercles about one-half the length of the inner side of the first antennal joint (fig. 29) .... **Euceraphis** Walker

— Inner side of antennal tubercles more than one-half the length of the inner side of the first antennal segment (figs. 27–28) .... **Calaphis** Walsh

6. Antennae longer than body, except in *Callipterinella*, with VI spur not much shorter than VI base (fig. 31) 7

— Antennae shorter than the body, with VI spur very short, often being little more than a nail-like process (fig. 34) 9

7. VI spur considerably longer than VI base, being one and one-half to two times as long. Anal plate emarginate but not deeply bilobed. **Callipterinella** Van der Goot

— VI spur about equal to or shorter than VI base. Anal plate deeply bilobed 8

8. VI spur and VI base subequal (fig. 31). Cornicles twice as long as broad in the middle and constricted in the middle (figs. 26, 32). **Myzocallis** Passerini

— VI spur shorter than VI base (fig. 30). Cornicles much broadened at base (fig. 33) .... **Eucallipterus** Schouteden

9. VI spur less than one-half the length of VI base (fig. 34). Cornicles not longer than broad at the base, and constricted in the middle (fig. 35). **Chromaphis** Walker

— VI spur at least one-half as long at VI base (figs. 63, 66). Cornicles short, about as long as broad and placed on a broad base .... **Callipterus** Koch

2. Genus **Drepanosiphum** Koch

Koch, Die Pflanzenläuse, p. 201, 1855. Type *Aphis palantanoides* Schrank.

4. **Drepanosiphum platanoides** (Schrank)

Figures 21, 24, 36

Schrank, Fauna Boic., vol. 2, p. 1206, 1801. *Aphis* (orig. desc.).

Wilson, Jour. Econ. Ent., vol. 2, p. 349, 1909 (desc. ala. vivi., ala. ovi. females).

Davidson, Jour. Econ. Ent., vol. 3, p. 377, 1910 (list).

Essig, Pom. Jour. Ent., vol. 4, p. 759, 1912 (list).

Records.—*Acer macrophyllum, A. negundo;* Berkeley, 1915 (Essig); Stanford University, October, 1914, April, 1915; *A. pseudoplatanus*, Stanford University, November, 1914 (Morrison); *A. saccharum*, Berkeley, June, 1915; *Platanus racemosus*, Stanford University (Davidson); *Acer* sp., San Lorenzo, 1908 (Wilson).

This is a very common species in the San Francisco Bay region on various species of maples, and on box elder and western sycamore. In April the alate and apterous viviparous females are abundant, remaining so throughout the summer and early fall. In the later fall (October and November) the sexes appear. Just where the eggs are laid the author is unable to say. A curious fact is that the oviparous females are alate as well as apterous. The author has never seen the alate forms, but Wilson (1908) describes them.

3. Genus **Drepanaphis** Del Guercio

Del Guercio, Rivista di patologia vegetable, vol. 4, pp. 49-53, 1909. Type *Siphonophora acerifolii* Thomas.

5. **Drepanaphis acerifolii** (Thomas)

Figures 23, 37

Thomas, Illinois Lab. Nat. Hist., Bull. 2, p. 4, 1878. *Siphonophora* (orig. desc.).
Clarke, Can. Ent., vol. 35, p. 249, 1903. *Drepanosiphum* (list).
Sanborn, Kan. Univ. Sci., Bull. 3, p. 45, 1904. *Drepanosiphum* (desc. ala.).
Davidson, Jour. Econ. Ent., vol. 2, p. 303, 1909. *Drepanosiphum* (list).
Davidson, Jour. Econ. Ent., vol. 3, p. 380, 1910. *Macrosiphum* (list).
Essig, Pom. Jour. Ent., vol. 4, p. 760, 1912 (list).
Essig, Mon. Bull., Cal. Comm. Hort., vol. 3, p. 85, 1914 (list).
Essig, Mon. Bull., Cal. Comm. Hort., vol. 3, p. 445, 1914 (list).

Records.—*Acer* sp.: Stanford University (Davidson); Sacramento (Essig); Hanford, Fresno County (B. V. Sharp); *A. macrophyllum, A. saccharinum,* Berkeley, July to October, 1915; Riverside, October, 1916; *A. dasycarpum, A. platanoides,* Berkeley, 1915 (Essig); *Quercus* sp. (live oak), Berkeley (Clarke) (?).

This is as common a species on maple in the San Francisco Bay region as the preceding one. It has also been taken in the Sacramento and the San Joaquin valleys, and in southern California. It is a species easily recognized by its dark markings and the dorsal tubercles on the first and second abdominal segments.

4. Genus **Calaphis** Walsh

Figure 28

Walsh, Proc. Ent. Soc. Phila., vol. 1, p. 301, 1863. Type *C. betulella* n.sp.

6. **Calaphis betulaecolens** (Fitch)

Figures 27-38

Fitch, Cat. Homop. N. Y., p. 66, 1851. *Aphis* (orig. desc.).
Clarke, Can. Ent., vol. 35, p. 249, 1903. *Callipterus* (list).
Davidson, Jour. Econ. Ent., vol. 2, p. 301, 1909. *Callipterus* (list).
Davidson, Jour. Econ. Ent., vol. 3, p. 376, 1910. *Callipterus* (list).
Essig, Pom. Jour. Ent., vol. 3, p. 556, 1911 (syn.).
Davidson, Jour. Econ. Ent., vol. 5, p. 404, 1912 (desc. sexes).
Essig, Pom. Jour. Ent., vol. 4, p. 760, 1912 (list).
Essig, Mon. Bull., Cal. Comm. Hort., vol. 3, p. 445, 1914 (list).
Baker, Proc. Ent. Soc., Washington, vol. 18, p. 186, 1916 (desc.).

Records.—*Betula* sp., Alameda, Contra Costa, Santa Clara counties (Clarke, Davidson, Essig, Morrison, and the author).

This is a common species of aphid on birch (*Betula* spp.) in the San Francisco Bay region. In the early part of March the eggs begin to hatch. In 1915 at Stanford University eggs began to hatch on March 8, the process continuing for several days. A month later both alate and apterous females were quite abundant; the alate females being undoubtedly the stem mothers, the apterae belonging to the second generation. Viviparous generations appeared throughout the summer. During August the sexes, alate males and apterous oviparous females, occurred. In 1914 the sexes and sexupara were noticed on August 28. Egg laying occurred shortly afterward, the eggs being laid in the crotches of the twigs and under the curled edges of the bark. Birch is the only recorded host plant.

5. Genus **Euceraphis** Walker

Walker, The Zoologist, p. 2001, 1870. Type *Aphis betulae* Koch.

KEY TO CALIFORNIA SPECIES

1. Body light green; third joint of antennae with about 13–18 sensoria on basal one half (fig. 39) .... **gillettei** Dvdn.

— Body yellow with dark markings on head and thorax, and often with as many as eight black transverse stripes on the abdomen (the number varies between none and eight); third antennal segment with 19–25 sensoria (fig. 40) .... **betulae** (Koch)

7. **Euceraphis betulae** (Koch)

Figures 29, 40

Koch, Die Pflanzenläuse, p. 217, 1855. *Callipterus* (orig. desc.).
Davidson, Jour. Econ. Ent., vol. 5, p. 405, 1913 (desc. ovi. female).
Davidson, Jour. Econ. Ent., vol. 7, p. 129, 1914 (desc. stem mother).

Records.—*Betula* sp.: Oakland (Davidson); Palo Alto, March to April, 1915.

Davidson lists this species, describing the stem mother and oviparous female from the San Francisco Bay region. The author found it in Palo Alto during March and April, 1915, on *Betula alba*. According to Davidson the stem mothers hatch from the eggs about the middle of February, feeding on the stems until the leaves open in March. The viviparous generations occur during the summer. He took the oviparous females in November. His description of the stem mother gives three dusky transverse bands on the abdomen. The author has found this to be variable, the number ranging from none to eight.

8. **Euceraphis gillettei** Davidson

Figure 39

Clarke, Can. Ent., vol. 35, p. 248, 1903. *Lachnus alnifoliae* Fitch (list).
Davidson, Jour. Econ. Ent., vol. 2, p. 300, 1909. *L. alnifoliae* Fitch (list).
Davidson, Jour. Econ. Ent., vol. 3, p. 375, 1910. *L. alnifoliae* Fitch (list).
Essig, Pom. Jour. Ent., vol. 4, p. 773, 1912. *Lachnus alnifoliae* Fitch (list).
Essig, Pom. Jour. Ent., vol. 4, p. 773, 1912. *Lahnus alnifoliae* Fitch (note).
Davidson, Jour. Econ. Ent., vol. 8, p. 421, 1915 (orig. desc.).

Records.—Alnus rhombifolia; Berkeley (Clarke), Stanford University, San Jose, Walnut Creek (Davidson), Stanford University, March, 1915.

This species was reported from alder by Clarke and Davidson as *Lachnus alnifoliae* Fitch. Essig, in his Host plant list of California Aphididae, lists *Callipterus alnifoliae* (Fitch) on *Alnus rhombifolia,* but later states that this citation should be *Lachnus alnifoliae* Fitch. Therefore he referred to this new species of Davidson. The author took both apterous and alate viviparous females of this species on *Alnus rhombifolia,* along the banks of the San Francisquito Creek, near Stanford University, on March 19, 1915. During the spring it was quite common there.

6. Genus **Eucallipterus** Schouteden

Schouteden, Mem. Soc. Ent. Belg., vol. 12, 1906. Type *Aphis tiliae* Linn.

KEY TO CALIFORNIA SPECIES

1. Wings hyaline; III pale except at the apex, with 5–7 sensoria on the basal one-fifth (fig. 41) .... **flava** (Dvdn.)
2. Wings with veins clouded; III with apical one-fifth and basal one-half dusky, and with about 13–15 sensoria on the basal one-half (fig. 42). **tiliae** (Linn.)

9. **Eucallipterus flava** (Davidson)

Figure 41

Davidson, Jour. Econ. Ent., vol. 5, p. 406, 1912. *Euceraphis* (orig. desc.).
Davidson, Jour. Econ. Ent., vol. 8, p. 423, 1915 (desc. sexes).

Records.—Alnus rhombifolia; San Jose, Walnut Creek (Davidson), Stanford University (Morrison).

This is an uncommon species in the San Francisco Bay region on *Alnus rhombifolia,* occurring on the under side of the leaves. The author has never collected it, but has specimens from Davidson, taken in April, 1913, near Walnut Creek, Contra Costa County. According to Davidson the sexes appear in October, egg laying occurring during the first part of November. The eggs are laid at the axils of the new buds and on the twigs or canes. These hatch the following spring, the stem mothers being found in the early part of April.

10. **Eucallipterus tiliae** (Linn.)

Figures 7, 30, 33, 42, 50

Linnaeus, Syst. Nat., vol. 2, p. 734, 1735. *Aphis* (orig. desc.).
Davis, Ann. Ent. Soc. Amer., vol. 2, p. 33, 1909. *Callipterus* (desc., biblio.).
Davidson, Jour. Econ. Ent., vol. 2, p. 302, 1909. *Callipterus* (list).
Davidson, Jour. Econ. Ent., vol. 3, p. 372, 1910. *Callipterus* (list).
Davidson, Jour. Econ. Ent., vol. 3, p. 376, 1910. *Callipterus* (list).
Essig, Pom. Jour. Ent., vol. 4, p. 763, 1912 (list).

Records.—Tilia americana, Tilia europea; Stanford University (Davidson), Berkeley, August, 1914 (Essig); Stanford University, April to May, 1915; Berkeley, June, 1915.

In the San Francisco Bay region this very pretty aphid is quite common on basswood or linden. The author has taken it throughout April, May, and June. Essig found it abundantly in August. It is very easily recognized when found at rest on the under side of the leaves of its host by the two black lines extending from the front of the head along the margins of the thorax and joining with the costal margins of the wings. It so appears that these lines are continuous from the front to the tip of the wings.

7. Genus **Myzocallis** Passerini

Passerini, Gli Afidi, p. 28, 1860. Type *Aphis coryli* Goetze.

KEY TO CALIFORNIA SPECIES

1. Wings hyaline 6
— Wings not hyaline, with portions shaded (fig. 262) 2
2. Costal cell of wings hyaline (figs. 266, 267) 3
— Costal cell of forewings dusky or shaded (figs. 263, 264) 5
3. First discoidal vein dusky, otherwise the wing is hyaline. VI with spur shorter than base. Apical one-half of III dusky (fig. 47). Cornicles pale. Found on *Alnus* spp. .... **alnifoliae** (Fitch)
— Wings not as above (figs. 266, 267). VI with spur either equal to or longer than base. III with less than apical one-half dusky 4
4. Cornicles pale. Abdomen without dusky dorsal markings. On *Quercus* spp. **maureri** Swain
— Cornicles dusky (fig. 62). Abdomen with dusky dorsal markings. On *Castanea* spp. and *Quercus* spp. .... **davidsoni** Swain

5. Cornicles pale. Wings with greater portion cloudy (fig. 262). Antennae with only tips of III to VI dusky. On *Quercus* spp. ....**discolor** (Monell)
— Cornicles pale with apex dusky. Wings with dusky band along costal margin (fig. 263). Antennae with tips of III and IV, apical one-half of V, and all of VI and spur dusky. On *Quercus* spp. ....**bellus** (Walsh)
6. Abdomen with four spine-like tubercles on the dorsum of the first segment. VI with base and spur subequal, III being considerably longer than both. Cornicles pale, small, and inconspicuous. On *Ulmus* spp. **ulmifolii** (Monell)
— Abdomen without tubercles as above 7
7. III shorter than VI (base and spur). On *Quercus* spp. ......**punctatus** (Monell)
— III not shorter than VI (base and spur) 8
8. VI with spur about twice as long as base (fig. 44). Cornicles pale. On *Corylus* spp. ....**coryli** (Goetze)
— VI with spur at most only slightly longer than base 9
9. III with apex only dusky (figs. 57, 58). Cauda pale 10
— III dusky throughout (fig. 268) or with apex and a band near the base dusky (fig. 48). Cauda dusky 11
10. Cornicles pale. Antennae longer than body. Sensoria on III (two or three in number) small and located close to the base of the segment (fig. 57). On *Pasania* spp. ....**pasaniae** Dvdn.
— Cornicles dusky, at least apical one-half. Antennae not longer than the body. Sensoria on III (five or more in number) fairly large and on basal two-thirds of segment (fig. 58). On *Quercus* spp.......................**quercus** (Kalt.)
11. Abdomen with dusky dorsal markings. III dusky throughout (fig. 268). On *Arundo* spp. ....**arundinariae** Essig
— Abdomen without dusky dorsal markings. III with apex and band near base dusky (fig. 48). On *Arundo* spp. ....**arundicolens** (Clarke)

11. **Myzocallis alnifoliae** (Fitch)

Figure 47

Fitch, Cat. Homop. N. Y., p. 67, 1851. *Lachnus* (orig. desc.).
Essig, Pom. Jour. Ent., vol. 4, p. 764 (762), 1912. *M. alni* (Fabr.) (desc. viviparae).
Baker, Jour. Econ. Ent., vol. 10, p. 421, 1917 (note).
Records.—Alnus rhombifolia; Santa Paula (Essig).

Only once has this species been taken in California, by Essig in August, 1911, near Santa Paula, Ventura County. At that time it was very abundant on the under side of the leaves, causing a large amount of sooty mold.

12. **Myzocallis arundicolens** (Clarke)

Figures 22, 48, 51, 52

Clarke, Can. Ent., vol. 35, p. 249, 1903. *Callipterus* (orig. desc.).
Davidson, Jour. Econ. Ent., vol. 2, p. 301, 1909. *Callipterus* (list).
Davidson, Jour. Econ. Ent., vol. 3, p. 376, 1910. *Callipterus* (list).
Essig, Pom. Jour. Ent., vol. 4, p. 762, 1912 (list, in part).
Essig, Univ. Calif. Publ. Entom., vol. 1, p. 305, 1917 (desc.).

Records.—Bamboo, Berkeley (Clarke, Essig); *Arundinaria japonica*, Berkeley, June, 1915.

In the San Francisco Bay region and in the Sacramento Valley this species is often found infesting the upper and lower surfaces of the leaves of various bamboos, particularly species of *Arundinaria*, *Bambusa*, and *Phyllostachys*, and the giant reed (*Arundo donax*). Reports list it from Alameda, Sacramento, San Francisco, and Santa Clara counties. The species described by Davidson (1914) as *Eucallipterus arundicolens* (Clarke) and reported from southern California by Essig (1912) proves to be distinct, and was described by Essig (1917) as *M. arundinariae*. The following brief description is from a collection made by the author on June 9, 1915, from *Arundinaria japonica* on the campus of the University of California in Berkeley.

Alate viviparous female.—(Second generation?) Prevailing color, pale yellow. Head twice as wide as long, pale yellow, with prominent red eyes. Antennal tubercles absent. Antennae longer than body; formula III, IV, V, VI spur, VI base, I, II. Segments all pale except the margins of I and II, the apices of III, IV, V, and a band about one-sixth the length of III a short distance from the base of III (fig. 48), which are black, and VI which is slightly dusky. There are five or six transverse secondary sensoria on III, located in the dark band. The usual primary sensoria are present on V and VI, and the usual accessor sensoria on VI. Beak pale and short, reaching only to the middle of the first coxae. Thorax and abdomen normal, pale yellow, without tubercles or dusky markings. Cornicles (fig. 51) pale, short, broader at base than at apex. Cauda short, constricted in the middle, with distal end black. Anal plate (fig. 52) pale, deeply bilobed. Wings normal, hyaline, with the first and second discoidal veins and the base of the stigmal vein darker than the others. There is a perceptible shading at the tip of each vein.

Measurements: Body length 1.326 to 2.023 mm. (av. 1.644 mm.), width of thorax 0.51 to 0.68 mm. (av. 0.612 mm.), antennae total 2.839 to 3.077 mm. (av. 2.9299 mm.), III 0.8925 to 0.986 mm. (av. 0.9324 mm.), IV 0.578 to 0.663 mm. (av. 0.6423 mm.), V 0.527 to 0.561 mm. (av. 0.5403 mm.), VI base 0.306 to 0.323 mm. (av. 0.3103 mm.), VI spur 0.34 to 0.425 mm. (av. 0.3691 mm.), cornicle 0.595 to 0.765 mm. (av. 0.7002 mm.), cauda 0.153 mm., wing length 2.25 to 3.96 mm. (av. 2.9097 mm.), width 1.02 to 1.122 mm. (av. 1.071 mm.), expansion 6.341 to 6.97 mm. (av. 6.6555 mm.).

13. **Myzocallis arundinariae** Essig

Figure 268

Essig, Pom. Jour. Ent., vol. 4, p. 762, 1912. *M. arundicolens* (Clarke) (in part).
Davidson, Jour. Econ. Ent., vol. 7, p. 129, 1914. *Eucallipterus arundicolens* (Clarke) (desc. viviparae).
Essig, Univ. Calif. Publ. Entom., vol. 1, pp. 302–305, 1917 (orig. desc.).

Records.—*Arundo* sp., San Francisco Bay region (Davidson); *Arundinaria japonica,* Santa Barbara (Essig); Riverside, January to May, 1917; *Arundo donax,* San Diego, April to June, 1916.

This is the commonest bamboo-infesting species in southern California and parts of central California. For some time it was considered as *M. arundicolens* (Clarke) but this past year Essig pointed out the differences, describing it as a new species.

14. **Myzocallis bellus** (Walsh)

Figures 45, 46

Walsh, Proc. Ent. Soc. Phila., vol. 1, p. 299, 1862. *Aphis* (orig. desc.).
Essig, Pom. Jour. Ent. Zool., vol. 7, pp. 195–200, 1915. *Callipterus* (desc.).

Records.—*Quercus agrifolia,* Alhambra, Los Angeles County (Essig); Ventura (Essig).

Two collections have been made of this species in California, both in southern California, in January, 1912, in Alhambra, and in May, 1913, in Ventura. Both of these consisted only of the alate females (stem mothers), and were described by Essig.

15. **Myzocallis davidsoni** Swain

Figures 60, 61, 62, 267

Clarke, Can. Ent., vol. 35, p. 249, 1903. *Callipterus castaneae* Fitch (list).
Davidson, Jour. Econ. Ent., vol. 3, p. 376, 1910. *Callipterus castaneae* (Buckton) (list).
Davidson, Jour. Econ. Ent., vol. 5, p. 405, 1912. *Calaphis castaneae* (Buckton) (desc. sexuales).
Essig, Pom. Jour. Ent., vol. 4, p. 760, 1912. *Calaphis castaneae* (Fitch) (list).
Swain, Trans. Am. Ent. Soc., vol. 44, p. 1, 1918 (orig. desc.).

Records.—*Castanea* sp., Berkeley (Clarke, Essig, Swain), Stanford University (Davidson, Swain), San Jose (Davidson); *Quercus pedunculata,* Berkeley (Swain, Essig).

This species was first reported in California by Clarke as *Callipterus castaneae* Fitch and later by Davidson as *Callipterus castaneae*

Buckton. Recently the author described the species from specimens taken in Berkeley on chestnut and oak. It cannot be the *Callipterus castaneae* of Fitch, because the latter is really a *Calaphis.* It may be the same species that Buckton had when describing his *Callipterus castaneae,* in which case his name would be dropped as Fitch's species has priority, and is replaced by the author's name, *M. davidsoni.* It is more or less common throughout the San Francisco Bay region on chestnuts, and in one case on two specimens of *Quercus pedunculata* in Berkeley. The stem mothers appear during the late spring, in April and May. Viviparous generations are produced throughout the summer, the sexuales occurring in October and November.

16. **Myzocallis coryli** (Goetze)

Figures 43, 44, 53, 54

Goetze, Ent. Beiträge, vol. 2, p. 311, 1778. *Aphis* (orig desc.).
Clarke, Can. Ent., vol. 35, p. 249, 1903. *Callipterus* (list).
Davis, Jour. Econ. Ent., vol. 3, p. 417, 1910. *Callipterus* (desc.).
Essig, Pom. Jour. Ent., vol. 4, p. 762, 1912 (list).

Records.—*Corylus* sp., Berkeley (Clarke); *Corylus rostrata,* San Francisco Bay region (Davidson); *C. rostrata* var. *californica, C. maxima,* Berkeley, August, 1914, June to July, 1915.

In the San Francisco Bay region this species is quite common on alder. During the seasons of 1914 and 1915 the author observed it to be very abundant on species of alder on the University of California campus. He has never found it in the south, however.

17 **Myzocallis discolor** (Monell)

Figures 262, 263

Monell, U. S. Geol. Geog. Surv., Bull. 5, p. 30, 1879. *Callipterus* (orig. desc.).
Williams, Univ. Neb. Studies, vol. 10, p. 115, 1910. *Callipterus* (desc.).

Record.—*Quercus macrocarpa,* Sacramento, October, 1916 (Davidson).

The author received specimens of this species from Davidson, which were found in October, 1916, on *Quercus macrocarpa* in Sacramento. The determination was made by Davis. Below are a few descriptive notes to supplement Williams' description listed above.

Alate viviparous female.—Antennae about as long as body, III the longest segment, followed by IV, VI, and V. VI spur is slightly longer than the base. The antennae are rather slender as compared with other species of this genus. Primary sensoria are present on V and VI as usual, and accessory sensoria on VI. There are about seven secondary sensoria on III (fig. 262), which are more or less oval to circular, and located on the basal two-thirds of the segment. The cornicles, cauda, and anal plate are typical of the genus.

Measurements: Body length 1.28 to 1.37 mm., antenna total 1.41 mm., III 0.459 mm., IV 0.306 mm., V 0.264 mm., VI 0.289 mm. (base 0.119 mm., spur 0.17 mm.), cornicles 0.68 mm., wing length 2.074 to 2.414 mm., width 0.68 to 0.833 mm. The two dusky transverse bands across the fore wings (fig. 263) constitute the most distinguishing character. The branching of the third discoidal is quite variable.

18. **Myzocallis punctatus** (Monell)

Monell, U. S. Geol. Geog. Surv., Bull. 5, p. 31, 1879. *Callipterus* (orig. desc.).

Clarke, Can. Ent., vol. 35, p. 249, 1903. *Callipterus hyalinus* Monell (list).

Essig, Pom. Jour. Ent., vol. 4, p. 762, 1912. *M. hyalinus* (Monell) (list).

Record.—*Quercus imbricata*, Berkeley (Clarke).

This is a doubtful species, reported only by Clarke from *Quercus imbricata* in Berkeley. It is the author's opinion that this is the same species listed by Davidson as *M. quercus* (Kalt.).

19. **Myzocallis maureri** Swain

Figures 55, 56, 266

Swain, Trans. Am. Ent. Soc., vol. 44, p. 4, 1918 (orig. desc.).

Records.—*Quercus agrifolia*, Berkeley (Swain); *Quercus kelloggii*, Julian, San Diego County (Swain).

This species has been taken in Berkeley and in the Cuyamaca Mountains of San Diego County by the author. Essig has also taken it in Berkeley. It is never abundant, but the author has observed it several times and in several places in the localities mentioned.

20. **Myzocallis pasaniae** Dvdn.

Figure 57

Davidson, Jour. Econ. Ent., vol. 8, p. 424, 1915 (orig. desc.).

Records.—*Pasania densiflora*, Stevens Creek Canyon, Santa Clara County (Davidson), Berkeley, February, 1915 (Essig).

This is a species found occasionally on tanbark oak in the San Francisco Bay region. The author has never taken it but has specimens from Davidson and Essig.

21. **Myzocallis quercus** (Kalt.)

Figures 31, 32, 58

Kaltenbach, Monog. d. Pflanzenläuse, p. 98, 1843. *Aphis* (orig. desc.).
Davidson, Jour. Econ. Ent., vol. 2, p. 302, 1909. *Callipterus* (list).
Davidson, Jour. Econ. Ent., vol. 3, p. 376, 1910. *Callipterus* (list).
Davidson, Pom. Jour. Ent., vol. 3, p. 399, 1911. *Callipterus* (list).
Essig, Pom. Jour. Ent., vol. 4, p. 762, 1912 (list).
Davidson, Jour. Econ. Ent., vol. 7, p. 130, 1914 (desc.).

Records.—Quercus agrifolia; Stanford University, San Jose, Penryn, Placer County (Davidson); *Q. lobata,* Santa Clara County (Davidson); Berkeley, 1915 (Essig); *Q. pedunculata,* Berkeley, August, 1914; *Q. douglasii,* Stanford University, November, 1910, April, 1911 (Morrison); *Q. robur,* Oakland (Davidson).

This is a variable species more or less common in the San Francisco Bay region and in the Sacramento Valley on various species of oaks. When he first reported it Davidson was doubtful of its identity. Later, however, it was identified by Peter Van der Goot[5] as this species.

22. **Myzocallis ulmifolii** (Monell)

Figure 59

Monell, U. S. Geol. Geog. Surv., Bull. 5, p. 29, 1879. *Callipterus* (orig. desc.).
Davidson, Jour. Econ. Ent., vol. 2, p. 301, 1909. *Callipterus* (list).
Davidson, Jour. Econ. Ent., vol. 3, p. 376, 1910. *Callipterus* (list).
Essig, Pom. Jour. Ent., vol. 4, p. 762, 1912 (list).

Records.—Ulmus sp., Stanford University (Davidson), *Ulmus americana,* Walnut Creek, October, 1913 (Davidson).

Davidson reports this as common on elms in the San Francisco Bay region. However, the author has never collected it. The following brief descriptive notes are from an alate viviparous female, taken in Walnut Creek by Davidson. The most distinguishing character is the presence of a pair of small but prominent tubercles on the middorsum of the first and second abdominal segments. The usual primary and accessory sensoria are present on V and VI. Secondary sensoria (fig. 59) are present on the basal one-half to two-thirds of III. These are transversely linear or oval, and number about six. The cornicles are very short, being fully as broad at the apex as long. Cauda and anal plate normal. Wings normal, radial vein indistinct, first discoidal curving toward base of wing. Body length 1.836 mm., width of thorax 0.578 mm., antennae total 1.309 to 1.326 mm., III

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[5] In 1917 George Shinji (Ent. News, vol. 27, February, 1917) described three species, *M. essiggi* n.sp., *M. woodworthi* n.sp., and *M. hyalinus* (Monell), all of which are undoubtedly but varieties of this species, *M. quercus* (Kalt.).

0.442 mm., IV 0.255 to 0.272 mm., V 0.221 to 0.2465 mm., VI 0.255 mm. (base 0.136 mm., spur 0.119 mm.), cornicles height 0.034 mm., diameter at apex 0.034 mm., wing length 1.581 to 1.768 mm., width 0.663 to 0.68 mm., expansion 3.825 mm.

8. Genus **Chromaphis** Walker

Walker, The Zoologist, p. 2001, 1870. Type *Lachnus juglandicola* Kalt.

23. **Chromaphis juglandicola** (Kalt.)

Figures 34, 35

Kaltenbach, Monog. d. Pflanzenläuse, p. 151, 1843. *Lachnus* (orig. desc.).
Essig, Pom. Jour. Ent., vol. 1, p. 51, 1909. *Callipterus* (desc. vivi.).
Essig, Pom. Jour. Ent., vol. 4, p. 763, 1912 (list).
Davidson, U. S. Dept. Agr., Bull. 100, pp. 2–19, 1914 (desc. all forms).

Records.—*Juglans regia;* San Francisco Bay region, southern California.

This walnut aphis is the most abundant and injurious of the species attacking walnut in California. It is more or less abundant throughout the San Francisco Bay region, while in southern California during certain seasons it is an important pest. Davidson (1914) has described all the forms and studied the life history carefully, so but little comment is necessary. In 1915 the author observed the young stem mothers on March 22 in Sunnyvale, Santa Clara County. Three weeks later the second generation was well advanced. From the first of May on, in 1916, the viviparae were abundant on walnuts throughout San Diego County, from nursery stock in San Diego to a few cultivated trees at Santa Ysabel (altitude 3000 feet). From the middle of October until well into December, 1916, the sexuales were found throughout Los Angeles and Riverside counties.

9. Genus **Callipterus** Koch

Koch, Die Pflanzenläuse, p. 208, 1855. Type *Aphis juglandis* Kalt.

The two members of this genus in California have been considered heretofore as species of *Monellia* Oestlund (genus 10), but according to Davis[6] they can not be so considered for in *Monellia* the wings are laid flat on the abdomen when at rest. This is found only in *Monellia caryella* (Fitch). Incidentally it may be remarked that the species known by that name in California does not have that habit, so should really be placed in this genus, *Callipterus* Koch. However, as it is identical with eastern specimens, except for this habit, the author has thought best to retain it in *Monellis,* at least for the time being.

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[6] Essig, E. O., Beneficial and Injurious Insects of California, Mon. Bull. Cal. Comm. Hort., vol. 4, p. 83, 1915.

KEY TO CALIFORNIA SPECIES

1. VI spur about equal to or slightly longer than VI base. Tibiae mostly pale. **caryae** Monell

— VI spur shorter than VI base. Tibiae entirely dark. Considerably larger than preceding species .... **californicus** (Essig)

24. **Callipterus californicus** (Essig)

Figures 63, 64

Essig, Pom. Jour. Ent., vol. 4, p. 767, 1912. *Monellia* (orig. desc.).
Davidson, U. S. Dept. Agr., Bull. 100, p. 34, 1914. *Monellia* (list, key to walnut aphids).

Records.—Juglans californica (California black walnut); Santa Paula.

In 1912 Essig described this species from specimens taken near Santa Paula in July, 1911. No other definite collections are known to the writer, although Essig reports it as more or less abundant on the California black walnut throughout the southern part of the state. Davidson has not found it in the San Francisco Bay region, nor has the author ever observed it, either in the bay region or in southern California.

25. **Callipterus caryae** Monell

Figures 65, 66

Monell, U. S. Geol. Geog. Surv., Bull. 5, p. 31, 1879 (orig. desc.).
Clarke, Can. Ent., vol. 35, p. 249, 1903 (list).
Davidson, Jour. Econ. Ent., vol. 2, p. 301, 1909 (list).
Davidson, Jour. Econ. Ent., vol. 3, p. 376, 1910 (list).
Essig, Pom. Jour. Ent., vol. 4, p. 764, 1912. *Monellia* (list).
Davidson, U. S. Dept. Agr., Bull. 100, pp. 19–26, 1914. *Monellia* (desc. all forms).

Records.—Juglans regia, J. californica; Berkeley, Stanford University, San Jose, San Francisco Bay region.

This species is more or less common in the San Francisco Bay region on walnuts. Davidson has described all the forms and noted its life history. The author has not taken the species.

10. Genus **Monellia** Oestlund

Oestlund, Minn. Geol. Nat. Hist. Surv., Bull. 4, p. 44, 1887. Type *Aphis caryella* Fitch.

This genus, as described by Oestlund, differs from *Callipterus* particularly in the position of the wings when the insects are at rest. In *Callipterus* they are held roof-like over the body as is usual in aphids. but in *Monellia* they are laid flat on the abdomen. It includes but the one species, *M. caryella* (Fitch).

26. **Monellia caryella** (Fitch)

Figures 25, 67, 68

Fitch, Insects N. Y., vol. 1, p. 163, 1855. *Aphis* (orig. desc. apt. vivi.).
Fitch, Ins. N. Y., vol. 3, p. 448, 1856. *Callipterus* (first desc. ala. vivi.).
Davidson, Jour. Econ. Ent., vol. 7, p. 132, 1914 (list).
Davidson, U. S. Dept. Agr., Bull. 100, pp. 26–34, 1914 (desc. all forms).

Records.—Juglans californica, J. Nigra, J. regia; San Jose, Walnut Creek (Davidson); Stanford University, May to June, 1915.

A more or less common species on both the native black walnut, and the cultivated walnut in the San Francisco Bay region. This species, while very similar to the preceding species, is probably the more common of the two. The following table of differences is taken from Davidson:[7]

Form	*Callipterus caryac* Monell	*Monellia caryella* (Fitch)
Alate viviparous female	Antennal joint III very slightly thickened basally.	Antennal joint III quite noticeably thickened for its basal half.
	Sensoria on antennal joint III occupying basal half or two-thirds.	Sensoria on antennal joint III occupying basal third.
	Antennal joint VI and its spur or filament subequal, or VI less than spur.	Antennal joint VI one-third as long again as its spur or filament.
	Dusky knee spots often present.	Dusky knee spots absent.
Pupa of viviparous	Four longitudinal rows of capitate spines.	Six longitudinal rows of capitate spines.
female Oviparous female	Smaller than viviparous female.	Larger than viviparous female.
	Four longitudinal rows of cipitate spines.	Six longitudinal rows of capitate spines.

This species is distinct from the preceding and according to Morrison, who has examined eastern species, is structurally identical except in the matter of the wings. He writes as follows:

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[7] Davidson, W. M., Walnut aphides in California, U. S. Dept. Agr., Bull. 100, p. 28, 1914.

> I made a very careful study of specimens from California, sent me by Davidson, and of specimens collected both in Indiana and New York (type locality). I was unable to find any structural differences that would definitely separate the two lots of specimens, with the exception of the position of the wings. These are laid flat when at rest in the eastern specimens, but are not so in the Californian specimens, according to Davidson. In spite of this apparent agreement, I feel that the two must be distinct.

If this is the case, that the wings are not laid flat at rest, this species must belong to the genus *Callipterus,* and therefore cannot be *Monellia caryella* (Fitch). However, the author has not had an opportunity to study this carefully, so leaves it as it is, calling this California species *Monellia caryella* (Fitch).

Because of the fact that all the species of aphids on walnut are so closely related, and so very similar in structure, a key to separate them, one from another, is given here. This key is adapted from Davidson.[8]

1. Cornicles quite evident, about as long as wide. **Chromaphis juglandicola** (Kalt.)
— Cornicles barely perceptible, considerably wider than long 2
2. Tibiae of alate viviparae entirely dusky .... **Callipterus californicus** (Essig)
— Tibiae of alate viviparae mostly pale 3
3. VI spur longer than VI base. Oviparous females with four longitudinal rows of capitate hairs .... **Callipterus caryae** Monell
— VI spur shorter than VI base. Oviparous females with six longitudinal rows of capitate hairs .... **Monellia caryella** (Fitch)

11. Genus **Callipterinella** Van der Goot

Van der Goot, Zur Systematic der Aphiden, 1913. Type *Aphis* (*Callipterus*) *betularius* Kaltenbach.

27. **Callipterinella annulata** (Koch)

Koch, Die Pflanzenläuse, p. 1855. *Chaitophorus* (orig. desc.).
Gillette, Jour. Econ. Ent., vol. 3, p. 367, 1910, *Chaitophorus betulae* (Buckton) (list).
Davidson, Jour. Econ. Ent., vol. 10, p. 292, 1917 (desc.).

Records.—Betula alba; Oakland, Walnut Creek (Davidson).

This species has been reported by Davidson as infesting the leaves and shoots of the white birch in the San Francisco Bay region. It is unknown to the author.

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[8] *Ibid.*, p. 35.

Tribe **Chaitophorini** Wilson (**Lachnidea** Mordw. and **Chaitopheri** Mordw.)

Wilson, Can. Ent., vol. 42, pp. 385–387, 1910.

This tribe as considered by Wilson contains the following genera: *Arctaphis, Chaitophorus, Symydobius, Thomasia,* and *Sipha.* The author has followed Wilson's classification, having added, however, two genera described later by Essig: viz., *Micrella* and *Fullawaya.* Essig's genus *Eichochaitophorus* is a synonym of *Arctaphis* Walker (see discussion under no. 27). Mordwilko's groups Lachnoidea and Chaitophori are both included in this one tribe. In the former, Mordwilko includes *Symydobius* and *Pterochlorus,* and in the latter, *Cladobius, Melanoxanthus,* and *Chaitophorus.* Both *Cladobius* and *Melanoxanthus* are included in this paper in the tribe Pterocommini, being synonyms of the genus *Pterocomma* Buckton. Following is a description of the tribe Chaitophorini as given by Wilson (*op. cit.*):

> Antennae, except in *Sipha,* always six-segmented; in *Sipha* there are but five. Length variable; antennal tubercles wanting; antennae, legs, and body covered with hair-like bristles. Fore wings with two oblique veins and cubitus always twice forked; hind pair with two cross veins. Nectaries (cornicles) variable in length and size, but never longer than one-tenth the length of the body. The genera in this tribe are somewhat similar to those in the tribe *Callipterini,* but are easily distinguished by the shorter and heavier antennae and legs, as well as by the finer and more hair-like bristles.

The following key to the Californian genera has been adapted from Wilson and Essig:

1. Spur of sixth antennal segment at least three times as long as the segment 2
— Spur not three times as long as the segment. Cauda broadly rounded and without knobbed tip 4
2. Spur more than five times as long as the segment; cornicles longer than the base of the sixth segment .... **Chaitophorus** Koch
— Spur of sixth segment not more than five times as long as the segment; cornicles not longer than the base of the sixth segment 3
3. Cauda a knob on a quadrangular base (fig. 69). Spur about five times as long as sixth segment .... **Arctaphis** Walker
— Cauda tapering to a blunt tip which is usually straight across, not being rounded or constricted at the base (fig. 70). Spur but slightly more than three times as long as the sixth segment .... **Micrella** Essig
4. Spur of sixth segment shorter or scarcely longer than the segment; antennae nearly as long as the body .... **Symydobius** Mordwilko
— Spur considerably longer than sixth segment; antennae about one-half the length of the body 5
5. Cornicles absent; body with lateral tubercles .... **Fullawaya** Essig
— Cornicles present; lateral body tubercles wanting .... **Thomasia** Wilson

Genus **Chaitophorus** Koch

Koch, Die Pflanzenläuse, p. 1, 1854. Type *Aphis aceris* Linn.

There are at present no species of this genus in California; most of the species hitherto placed in it are now considered as belonging to the genus *Thomasia* Wilson.

12. Genus **Arctaphis** Walker

Walker, The Zoologist, p. 2000, 1870. Type *aphis populi* Linn.

This genus as defined by Wilson is represented in California by two species: *A. viminalis* (Monell) and *A. populifolii* (Essig). The latter was placed by Essig in a new genus, *Eichochaitophorus,* but there is not enough difference between these to warrant a new genus.

KEY TO CALIFORNIA SPECIES

1. Wings hyaline. Three-nine large sensoria on third antennal segment (fig. 71). IV half as long against as V .... **populifolii** (Essig)

— Wings subhyaline. About ten rather small sensoria on III. IV but very little longer than V .... **viminalis** (Monell)

28. **Arctaphis populifolii** (Essig)

Figures 69, 71

Essig, Pom. Jour. Ent., vol. 4, p. 722, 1912. *Eichochaitophorus* (orig. desc.).

Davidson, Jour. Econ. Ent., vol. 3, p. 375, 1910. *Chaitophorus populifoliae* (Fitch) (desc. male).

Davidson, Pom. Jour. Ent., vol. 3, p. 399, 1911. *Chaitophorus populifoliae* (Fitch) (list).

Records.—*Populus trichocarpa,* Santa Paula (Essig), Berkeley, September, 1915; *Populus fremontii,* Stanford University and Penryn, Placer County (Davidson); Menlo Park, San Mateo County, October, 1914 (Morrison); Berkeley, September, 1915; El Cajon, San Diego County, June, 1916; Riverside, October, 1916.

In 1912 Essig described this species from specimens taken on *Populus trichocarpa* at Santa Paula, and placed it in a new genus, *Eichochaitophorus.* He separated this genus from *Arctaphis* for the following reasons:

> According to Wilson the cauda [in *Arctaphis*] is a knob on a quadrangular base. The anal plate is broadly rounded. In the new genus [*Eichochaitophorus*] the style has a distinct neck and is situated on a very distinct conical base. The anal plate is deeply notched in the middle so as to make it somewhat forked as in the genus *Callipterus.*

Although the anal plate is somewhat notched, there is scarcely difference enough to warrant the forming of a new genus. In fact, in many specimens one cannot tell whether or not a notch is present. As to the cauda, consisting of the tip, a distinct neck, and a distinctly conical base, this is not greatly different from a cauda consisting of a knobbed tip on a quadrangular base. The only practical difference is in the base, being conical in one and quadrangular in the other. In *populifolii* (Essig) the base seems to be conical, yet one cannot be certain unless the specimen is mounted exactly.

This species, *A. populifolii* (Essig), as stated above, was described from specimens taken on *Populus trichocarpa* at Santa Paula. In 1910 Davidson found a species on *Populus fremonti* at Stanford University, and the following year at Penryn, Placer County, which he listed as *Chaitophorus populifoliae* (Fitch). A careful study of specimens from Davidson and the cotypes of Essig's species convinced the author that they were identical. Morrison writes that Davidson's specimens are not *C. populifoliae* (Fitch), so Essig's species is distinct. In September, 1915, the author observed a great number of specimens of this species on a weeping elm (*Ulmus* sp.) in Berkeley, which was in close proximity to some populars. However, none were seen to be feeding on the elm, all being restless and wandering over the leaves and branches. In southern California this is often found infesting the empty galls of *Thecabius populimonilis* Riley, such having been observed in San Diego and Riverside counties.

29. **Arctaphis viminalis** (Monell) ?

Monell, U. S. Geol. Geog. Surv., Bull. 5, p. 31, 1879. *Callipterus* (orig. desc.).
Clarke, Can. Ent., vol. 35, p. 248, 1903. *Chaitophorus* (list).
Davidson, Jour. Econ. Ent., vol. 3, p. 375, 1910. *Chaitophorus* (list).
Davidson, Pom. Jour. Ent., vol. 3, p. 398, 1911. *Chaitophorus* (list).
Essig, Pom. Jour. Ent., vol. 4, p. 716, 1912. *Thomasia* (list, key to Californian species of *Thomasia*).
Patch, Maine Agr. Exp. Sta., Bull. 213, p. 80, 1913. *Chaitophorus* (desc.).

Records—*Salix* spp.; Watsonville, Santa Cruz County, and Newcastle, Placer County (Clarke); Penryn, Placer County, and Stanford University (Davidson).

This species has been reported from Placer, Santa Clara, and Santa Cruz counties on various species of willow. The true *Chaitophorus viminalis* Monell is an *Arctaphis*, but whether or not the western species is the same as the eastern is a question. The author has never seen specimens of either and is therefore unable to make any further comment. He once thought the western species was identical with *Thomasia salicicola* (Essig), to which Morrison considers it very closely related, but Davidson assures him the two are distinct.

13. Genus **Micrella** Essig

Essig, Pom. Jour. Ent., vol. 4, p. 716, 1912. Type *M. monella* n.sp.

30. **Micrella monella** Essig

Figures 70, 72

Essig, Pom. Jour. Ent., vol. 4, p. 717, 1912 (orig. desc.).

Records.—Salix lasiolepis, Oxnard (Essig); *S. laevigata*, Santa Paula (Essig).

This species was taken twice by Essig, who described it, in 1910 near Oxnard, and in 1911 near Santa Paula. Since then it has never again been found. The author has had access to cotype specimens in Essig's collection.

14. Genus **Fullawaya** Essig

Essig, Pom. Jour. Ent., vol. 4, p. 735, 1912. Type *F. saliciradicis* n.sp.

31. **Fullawaya saliciradicis** Essig

Figure 75

Essig, Pom. Jour. Ent., vol. 4, p. 737, 1912 (orig. desc.).

Record.—Salix laevigata, Santa Paula, August, 1911 (Essig).

On the roots of willow near Santa Paula, Essig once found a large number of aphids, the greater part of which were apterae, although a few alates were present. Unable to identify them with any known species, or to fit them into any genus, he described them as this species. Since then they have not been taken. The author has had access to cotype specimens in Essig's collection.

15. Genus **Thomasia** Wilson

Wilson, Can. Ent., vol. 42, p. 386, 1910. Type *Chaitophorus populicola* Thomas.

This genus is separated from *Chaitophorus* principally by the comparative lengths of the antennae and the comparative lengths of the spur of the sixth antennal segment. In *Chaitophorus* (type *Aphis aceris* Linn.) the antennae are almost as long as the body, and the spur of the sixth segment is over five times as long as the base. In this genus the antennae are but about one-half as long as the body. and VI spur is but slightly longer than VI base.

KEY TO CALIFORNIA SPECIES

1. Wings hyaline 2
— Wings with veins clouded (fig. 275) .... **populicola** (Thomas)
2. III longer than VI (including spur) .... **negundinis** (Thomas)
— III not longer than VI (including spur) 3
3. IV with secondary sensoria .... **crucis** Essig
— IV without secondary sensoria .... **salicicola** Essig

32. **Thomasia crucis** Essig

Figure 76

Essig, Pom. Jour. Ent., vol. 4, p. 742, 1912 (orig. desc.).

Records.—*Salix macrostachya,* Santa Paula, August, 1911 (Essig).

Essig once found this species on the leaves of willow near Santa Paula. Since then it has never again been taken. The author has had access to cotype specimens in Essig's collection.

33. **Thomasia negundinis** (Thomas)

Thomas, Ill. Lab. Nat. Hist., Bull. 2, p. 10, 1878. *Chaitophorus* (orig. desc.).
Sanborn, Kan. Univ. Sci., Bull. 3, p. 35, 1904. *Chaitophorus* (desc.).
Davidson, Jour. Econ. Ent., vol. 3, p. 376, 1910. *Chaitophorus* (list).
Essig, Pom. Jour. Ent., vol. 4, p. 716, 1912 (list).

Records.—*Acer negundo,* Stanford University (Davidson); Salt Marshes, Palo Alto, May, 1912 (Morrison).

This species of *Thomasia* is quite common on box elder in the vicinity of Stanford University and Palo Alto. The author has never taken specimens, nor had access to any. Morrison writes that although he has never had access to eastern specimens of *T. negundinis* (Thos.) for comparison he is not able to convince himself that the western species is *negundinis.* The author is unable to form any opinion at present, having never seen specimens, hence lists the species as Davidson has done.

34. **Thomasia populicola** (Thomas)

Figures 77, 275

Thomas, Ill. Lab. Nat. Hist, Bull. 2, p. 10, 1878. *Chaitophorus* (orig. desc.).
Essig, Pom. Jour. Ent., vol. 1, p. 98, 1909. *Chaitophorus* (desc.).
Essig, Pom. Jour. Ent., vol. 4, p. 716, 1912 (list).

Records.—*Populus* spp., *Salix* spp., Santa Paula (Essig); Riverside, May, 1917; *Populus* sp., Canton, Broadwater County, Montana, July, 1915, R. W. Haegele; Edna Cañon, Boxelder County, Utah, August, 1916, R. W. Doane.

This species has been reported by Essig from Ventura County. The author has never taken the alates, but has had the opportunity of examining Essig's specimens, and specimens from Montana and Utah taken by Haegele and Doane. It is easily distinguished from other members of the genus by the broad, dark wing veins.

35. **Thomasia salicicola** (Essig)

Figure 78

Essig, Pom. Jour. Ent., vol. 3, p. 532, 1911. *Chaitophorus* (orig. desc.).
Davidson, Jour. Econ. Ent., vol. 3, p. 375, 1910. *Chaitophorus nigrae* Oestlund (?) (list).
Davidson, Pom. Jour. Ent., vol. 3, p. 398, 1911. *Chaitophorus nigrae* Oestlund (?) (list).
Essig, Pom. Jour. Ent., vol. 4, p. 619, 1912 (note).
Essig, Pom. Jour. Ent., vol. 4, p. 716, 1912 (list).

Records.—*Salix laevigata,* Santa Paula (Essig), *Salix nigra,* Lakeside, San Diego County, April, 1916; *Populus trichocarpa,* Santa Paula (Essig); *Salix* sp., San Jose, Stanford University, Penryn, Placer County (Davidson), Fillmore, Ventura County, March, 1911 (Essig).

Essig reported this from Ventura County, and the author has found it in San Diego County. It was observed to be in large colonies on the leaves and leaf petioles of the tender growth of willow, in company with *Siphocoryne carpreae* (Fabr.). Specimens taken by Davidson and listed as *Chaitophorus nigrae* Oestlund prove to be identical with this species.

16. Genus **Symydobius** Mordwilko

Mordwilko, Rap. Lab. Zool. Kap. Imp. Varch. Univ., 1895. Type *Aphis oblonga* Heyden.

Key to California Species

1. Anal plate half-moon-shaped 2
— Anal plate bilobed (fig. 271); cornicles pale, appearing white in life; antennae with about six to eight secondary sensoria on III, and one or two on IV (fig. 272) .... **chrysolepis** Swain
2. Spur of VI but a short thumb-like projection; sensoria on III numbering about six to ten; none on IV .... **agrifoliae** Essig
— Spur of VI longer, being equal to or longer than base of VI; fifteen to twenty sensoria on III, one or two on IV (figs. 73, 74) 3
3. Antennae for the most part dark, being dark brown or black; spur and base of VI equal, lateral abdominal tubercles present in apterae. **macrostachyae** Essig
— Antennate for the most part pale, being light brown or amber; spur of VI usually slightly longer than base; apterae without lateral abdominal tubercles .... **salicicorticis** Essig

36. **Symydobius agrifoliae** Essig

Essig, Univ. Calif. Publ. Entom., vol. 1, pp. 311–317, 1917 (orig. desc.).

Records.—Quercus agrifolia; Santa Paula (Essig).

This interesting aphid was taken in Ventura County on live oak during 1911. It differs from other members of this genus in the extremely short spur of the sixth antennal segment. The coloration is very similar to that of the next species, but the length of VI spur and the fact that the anal plate is not bilobed serves to distinguish it.

37. **Symydobius chrysolepis** Swain

Figures 269 to 274

Swain, Trans. Am. Ent. Soc., vol. 44, p. 6, 1918 (orig. desc.).

Records.—Quercus chrysolepis; Alpine, San Diego County (Swain).

This is a medium sized, brownish colored aphid found in 1916 infesting the terminal twigs and leaf petioles of maul oak in San Diego County. Its pale white cornicles are very conspicuous, and serve as a distinguishing character. The anal plate is bilobed, a character not found in other members of the genus, and one which may be sufficient for the separation of the species (and *S. albisiphus* Davis, in which the anal plate is also bilobed) from *Symydobius* into a new genus. However, the author believes it best to retain them in this genus at present. The apterous females were found to be heavily parasitized by the chalcid fly, *Closterocerus utahensis* Crawford var. *californicus* Girault.

38. **Symydobius macrostachyae** Essig

Figure 73

Essig, Pom. Jour. Ent., vol. 4, p. 727, 1912 (orig desc.).

Records.—Salix macrostachya; Santa Paula (Essig), Fresno, June, 1915.

Twice has this species been taken, once by Essig near Santa Paula and once by the author along the San Joaquin River near Fresno. It is found in fairly large colonies on the younger stems of willow. These colonies consist for the most part of apterae, only a very few alates being present.

39. **Symydobius salicicorticis** Essig

Figure 74

Essig, Pom. Jour. Ent., vol. 4, p. 731, 1912 (orig. desc.).

Record.—Salix.laevigata; Santa Paula (Essig).

Together with specimens of *Fullawaya saliciradicis* Essig, this was taken on willow along the Santa Clara River near Santa Paula in August, 1911. The colonies are found on the bark near the surface of the ground either just above or just below it. Essig reports that it is preyed upon quite extensively by the larvae of an undetermined species of syrphus fly. The author has had access to cotype specimens in Essig's collection.

Group **Lachnina** Passerini

Passerini, Gli Afidi, 1860.

In this group there are included two tribes, Lachnini Del Guercio and Pterocommini Wilson, following Wilson. Mordwilko places but the one tribe Lachnini in this group, including the genus *Pterocomma* Buckton in the tribe Chaitophori. However, to the author the grouping followed here seems more natural. The following key is adapted in part from Börner (Sorauer, Pflanzenkrankheiten, vol. 3, p. 665, 1913):

Sixth antennal segment with a short, thick (thumb-like) projection. Cornicles conical (fig. 91) or wart-like. Empodial hair short, and oftentimes indistinguishable (fig. 79) .... Tribe **Lachnini**

Sixth antennal segment with a slender projection (VI spur) which is about as long as the segment (VI base). Cornicles cylindrical or clavate (figs. 81, 82). Empodial hair practically as long as the claws (fig. 80). Tribe **Pterocommini**

Tribe **Pterocommini** Wilson

Wilson, Ann. Ent. Soc. Am., vol. 8, pp. 347–358, 1915.

This tribe, as considered by Wilson, contains but the one genus, *Pterocomma* Buckton. In a former paper (Can. Ent., vol. 43, p. 384, 1910) he recognized two genera: the one, *Melanoxantherium* Schouteden, in which the cornicles were swollen or vasiform, and the other, *Pterocomma* Buckton, in which the cornicles were cylindrical. He states in his later paper: "... after having further studied the group I am of the opinion that such a divsion is illogical, and if a division is necessary each species should form a different genus. It, therefore, seems more practical to confine all the species to a single genus." The characters of this tribe and genus are as follows:

Antennae with six segments and reaching near the base of the abdomen. Wings normally with venation as in *Aphis.* Nectaries [cornicles] short, but clavate. Cauda short and broadly rounded at the tip as in *Lachnini.* Entire body, antennae, and legs covered with long hairs as in *Lachnini.* As has already been pointed out by Oestlund, this group appears intermediate between the *Chaitophorini* and the *Lachnini.* Their habits and actions being in different ways similar to both.

17. Genus **Pterocomma** Buckton

Buckton, Monog. Brit. Aphides, vol. 2, p. 143, 1879. Type *P. pilosa* Buckton.

Key to California Species

1. Cornicles abruptly constricted at distal end, and without a distinct flange (fig. 81), the diameter of the opening being less than the diameter of the smallest part of the cornicle. Wing veins broad and shaded. **flocculosa** (Weed)
— Cornicles not so abruptly constricted and with a distinct flange. Wing veins normal 2
2. Cornicles about twice as long as their greatest diameter ....**smithiae** (Monell)
— Cornicles considerably longer than greatest diameter, and longer than hind tarsus ....**populifoliae** (Fitch)

40. **Pterocomma flocculosa** (Weed)

Figure 81

Weed, Insect Life, vol. 3, p. 291, 1891. *Melanoxanthus* (orig. desc.).
Wilson, Ann. Ent. Soc. Am., vol. 8, p. 350, 1915 (desc.).

Records.—*Salix* sp., Berkeley, March, 1915; 1916 (Essig).

In his paper on *Pterocomma* Wilson states that this species does not occur on the Pacific Coast. However, in March, 1915, the author found it rather abundantly on willow on the campus of the University of California in Berkeley. During the 1916 season Essig observed it to be quite common in Berkeley. The species is easily recognized in life by the white cottony flocculence covering the colonies on the bark.

41. **Pterocomma populifoliae** (Fitch)

Figures 82, 83

Fitch, Cat. Homop. N. Y., p. 66, 1851. *Aphis* (orig. desc.).
Davidson, Jour. Econ. Ent., vol. 2, p. 300, 1909. *Cladobius rufulus* n.sp. (desc.).
Davidson, Jour. Econ. Ent., vol. 3, p. 375, 1910. *Cladobius rufulus* Dvdn. (list).
Essig, Pom. Jour. Ent., vol. 4, p. 786, 1912. *Melanoxantherium rufulum* (Dvdn.) (desc.).
Wilson, Ann. Ent. Soc. Am., vol. 8, p. 353, 1915. *Pterocomma populea* (Kalt.) (desc.).
Baker, Can. Ent., vol. 48, pp. 280–282, 1916 (desc.).

Records.—*Salix* sp.; Stanford University (Davidson); Santa Paula (Essig); Walnut Creek, March, 1915 (Davidson); Grossmont, San Diego County, March, 1916; Lakeside, San Diego County, April, 1916; Stanford University, May, 1912 (*Morrison*); *Populus* sp.; Stanford University (Davidson); Palo Alto, March, 1915; *Populus carolinıana*, Banning, Riverside County, April, 1917.

This is a widely distributed species in California on various species of poplars and willows. Davidson first found it in 1909, describing it as a new species. In 1915 Wilson stated that it was synonymous with *P. populea* (Kalt.), but specimens sent him by the author he determined as *P. bicolor* (Oestlund). According to his paper the cornicles of *populea* (Kalt.) are about equal in length to the hind tarsi. Californian specimens have the cornicles considerably longer than the hind tarsi, but not twice as long as he states they are in *bicolor* (Oestlund). His figures of the antennae show that in *populea* VI base and spur are subequal, and in *bicolor* the spur is considerably longer than the base. The latter is true for the Californian species. His color notes of *populea* fit the Californian species very well. Baker identified *Aphis populifoliae* Fitch as a *Pterocomma* and places *rufulus* (Davidson) as a synonym. From a study of specimens taken in Santa Paula, Grossmont, Lakeside, Stanford University, and Walnut Creek, the author finds that Baker's description of *populifoliae* fits this species very well. Below are the measurements in microns of four alate specimens, together with the measurements of cornicles, antennae, and hind tarsi of one from Lakeside. (This was preserved for several months in alcohol before being mounted for study, and had shrunk considerably.)

An examination of the following table shows that in the California specimens the cornicles are always considerably longer than the hind tarsi, but never twice as long, and that the spur of six is always longer than the base, except in one case. This specimen is considerably

TABLE SHOWING MEASUREMENTS FOR *Pterocomma populifoliae* (Fitch) FROM DIFFERENT LOCALITIES IN CALIFORNIA.

	Body length	Width thorax	Antennae total	III	IV	V	VIb	VIs	Corni-cles	Hind tarsi	Wing length	Wing expansion
Santa Paula,	2159	850	1479	578	272	221	127	136	221	170	3519	8007*
August, 1911			1479	578	255	238	136	136	221	......	3689	
Walnut Creek,	2618	1020	1717	510	323	214	170	187	272	187	5100	11220†
March, 1915			1870	561	340	340	187	238	......	187	4930	
Stanford University,	3230	1241	2006	629	357	357	221	272	340	212	4675	10489
October, 1909			2040	612	357	357	204	306	340	221	4624	
Stanford University,	2703	1190	2023	578	374	340	204	340	374	238	......	......
April, 1915			2108	612	391	340	204	357	374	272	......	
Lakeside,	......	......	......	544	357	......	......	......	289	221	......	......
April, 1916			1853	561	340	306	187	272	306	221	......	
Average	2677	1075	1842	576	337	268	182	248	304	214	4425	9905

* Male (?).

† Antenna bent.

smaller than the others and has many more secondary sensoria, being a male. From this evidence this species is the same as Baker lists as *P. populifoliae* (Fitch) and should be so considered. The author has reared a number of specimens of a species of *Aphidius* from material obtained near Stanford University in May, 1915.

42. **Pterocomma smithiae** (Monell)

Monell, U. S. Geol. Geog. Surv., Bull. 5, p. 32, 1879. *Chaitophorus* (orig. desc.).

Davidson, Jour. Econ. Ent., vol. 2, p. 300, 1909. *Cladobius salicti* (Harris) (list).

Davidson, Jour. Econ. Ent., vol. 3, p. 375, 1910. *Cladobius salicti* (Harris) (list).

Essig, Pom. Jour. Ent., vol. 4, p. 786, 1912. *Melanoxantherium salicti* (Harris) (list).

Wilson, Ann. Ent. Soc. Am., vol. 8, p. 355, 1915 (desc.).

Records.—*Salix* spp., Stanford University (Davidson, Morrison).

Both Davidson and Morrison have taken this species in the vicinity of Stanford University on various species of willow. According to Wilson, with whom Morrison and Baker agree, this is *P. smithiae* (Monell), the *salicti* of Harris being synonymous. The sexuales were observed by Davidson in October, the eggs hatching in January.

Tribe **Lachnini** Del Guercio

Del Guercio, Redia, vol. 5, 1908.

This tribe is represented in California by three genera, viz., *Essigella* Del Guercio, *Tuberolachnus* Mordwilko, and *Lachnus* Burmeister, while there are six genera included in the tribe as it is here considered. Following is a brief characterization of the tribe adapted from Mordwilko:

' The body and appendages are very hairy, and usually quite large. The cauda is absent, the cornicles cupola-shaped, being black or brown in color. Sometimes they are reduced to mere pores or not fully developed [*Lachnus taxifolia* Swain]. The antennae in general are not longer than the head and thorax, six-jointed [except in *Essigella* Del Guercio], with the spur of the sixth segment very short, not being as long as the segment itself. The beak is almost always elongated, generally reaching to or beyond the middle of the abdomen. All this group possess the anatomical peculiarity that the narrowed hind end of the stomach is covered with the intestine. The stigma of the fore wing is elongate linear [in *Longistigma* Wilson it reached past the tip of the wing (fig. 89)]. The cubitus is twice-branched.

All the California species with the exception of *Tuberolachnus viminalis* (Fonsc.), which lives on willow, are found on conifers—*Pinus* sp., *Pseudotsuga* sp., or *Picea* sp.

Following is a key to the genera, adapted from Del Guercio, Wilson and Essig. In this key are included not only the California genera but the other three as well, in that an understanding of the characters is thus made easier.

1. Antennae six-segmented 2
— Antennae five-segmented (fig. 83) .... **Essigella** Del Guercio
2. Stigma exceptionally long, reaching beyond the tip of the wing (fig. 84). **Longistigma** (Wilson)
— Stigma not exceptionally long, not reaching beyond the tip of the wing (fig. 85) 3
3. First joint of the hind tarsus much shorter than half the second (fig. 86) 4
— First joint of the hind tarsus equal to or slightly longer than half the second (fig. 87) .... **Eulachnus** Del Guercio
4. Abdomen with horn-like tubercle on median dorsum between the cornicles, (Sometimes this cannot be made out in specimens mounted in balsam, but it is always readily discernible in fresh or alcoholic material). **Tuberolachmus** Mordwilko
— Abdomen without horn-like tubercle 5
5. Bases of first and second discoidal close together; third discoidal often very faint; wings slightly if ever clouded (fig. 85) .... **Lachnus** Burmeister
— Bases of first and second discoidals not so close together as in *Lachnus* Burm.; third discoidal plain; wings often darkly clouded ...... **Pterochlorus** Rondani

18. Genus **Essigella** Del Guercio

Del Guercio, Rev. di patal. veg., vol. 3, p. 328, 1909. Type *Lachnus californicus* Essig.

43. **Essigella californica** (Essig)

Figures 3, 5, 83

Essig, Pom. Jour. Ent., vol. 1, p. 1, 1909. *Lachnus* (orig. desc.).
Del Guercio, Pom. Jour. Ent., vol. 1, p. 73, 1909 (translation by C. F. Baker of Del Guercio's paper listed above).
Essig, Pom. Jour. Ent., vol. 4, p. 773, 1912 (list).
Essig, Pom. Jour. Ent., vol. 4, p. 780, 1912 (desc.).

Records.—*Pinus radiata;* Claremont, Los Angeles County, and Santa Paula (Essig); *Pinus sabiniana,* Stanford University, March, 1915; *Pinus* spp., Stanford University, March and April, 1912 (Morrison); Ontario, San Bernardino County, January, 1917.

This curious little aphid, described by Essig from specimens taken in Claremont, Los Angeles County, on *Pinus radiata,* has since been found in several parts of the state. Wilson has taken it in Oregon on *Pseudotsuga taxifolia,* and Patch in Maine on *Pinus strobus.* It is a small, slender, long-legged aphid, that clings fast to the pine needles and is extremely difficult to see. However, if a branch of pine is struck sharply and with considerable force over a white paper or cloth, a large number of these aphids will jar off.

19. Genus **Tuberolachnus** Mordwilko

Mordwilko, Ann. Mus. Zool. d. l'Acad. Imp. Sci., vol. 13, p. 374, 1908. Type *Aphis viminalis* Fonsc.

44. **Tuberolachnus viminalis** (Fonsc.)

Figure 86

Boyer de Fonscolmbe, Ann. Ent. Soc. France, vol. 10, p. 162, 1841. *Aphis* (orig. desc.).
Davidson, Jour. Econ. Ent., vol. 2, p. 299, 1909. *Lachnus* (list).
Davidson, Jour. Econ. Ent., vol. 3, p. 374, 1910. *Lachnus* (list).
Davidson, Pom. Jour. Ent., vol. 3, p. 398, 1911. *Lachnus dentatus* Le Baron (list).
Essig, Pom. Jour. Ent., vol. 4, p. 774 (772), 1912 (list).

Records.—*Salix* spp., Stanford University and Penryn, Placer County (Davidson); Ventura County (Essig); Stanford University, November, 1914; Berkeley, July, 1915; Riverside, July, 1916.

This extremely large aphid, which lives in large colonies on the branches of various species of willows, is found throughout the San Francisco Bay region, Sacramento Valley, and southern California, although it is not at all common. Davidson reports considerable parasitization by a species of *Epherdius*, and Essig infection from some bacterial or fungus disease. The large size and the presence of a dorsal abdominal tubercle are distinguishing characters.

20. Genus **Lachnus** Burmeister

Burmeister, Handbuch d. Entomologie, p. 91, 1835. Type *Lachnus faciatus*, n.sp.

This is the third largest genus of aphids in regard to the number of species in California. All the species are to be found on various conifers, usually feeding through the bark of the branches or trunk. Characters for distinguishing the species are hard to obtain, and those used by the author in the following key are of no value except with specimens of the alate viviparae. This key is not at all adequate, and is offered here merely as an aid. The author understands that Wilson is preparing a monograph of this genus, which will undoubtedly prove quite valuable.

Key to California Species

1. Beak reaching considerably beyond the third coxa 2
— Beak at most barely reaching to the third coxa 8
2. Beak reaching almost to or even beyond the tip of the abdomen 3
— Beak not reaching to the tip of the abdomen 4
3. First joint of hind tarsus more than one-third as long as the second joint. Legs black except the base of the femora and a broad ring near the base of the tibiae ....**ponderosa** Williams
— First joint of hind tarsus scarcely more than one-fourth as long as the second joint. Legs pale at the base of the femora and tibiae, black at tips. **oregonensis** Wilson
4. Body exceptionally large, being over 4 mm. long, usually about 5 mm., and over 2 mm. wide 5
— Body of average size, being from 2.5 mm. to 3 mm. long, and from 0.75 to 1.2 mm. wide 7
5. Third segment of antennae with many sensoria (eight or more), (figs. 88, 89) 6
— Third joint of antennae with but few or no sensoria, at most with one or two. First joint of hind tarsus a little less than half as long as the second. On *Pinus sabiniana* ....**sabinianus** n.sp.
6. Third joint of antennae with about 8–12 sensoria (fig. 88). Tibiae with a pale ring near the base. First joint of hind tarsus scarcely more than one-third the length of the second. On *Picea* sp. ....**vanduzei** n.sp.
— Third joint of the antennae with 19–20 sensoria (fig. 89). Tibiae without pale ring near base. First joint of hind tarsus almost one-half the length of the second. On *Pinus* sp. and *Abies* sp. ....**ferrisi** Swain
7. Beak not reaching to the middle of the abdomen. Segment three of the antennae almost as long as the fourth, fifth, and sixth together. Apex of stigma meeting the margin of the wing in an acute angle, and not terminated by a distinct vein (fig. 92). On *Pseudotsuga taxifolia.* **pseudotsugae** Wilson
— Beak reaching beyond the middle of the abdomen. Third antennal segment not nearly so long as the fourth, fifth, and sixth together. Apex of stigma meeting the wing margin in an obtuse angle, and terminated by a distinct vein (fig. 93). Apterous viviparous females with a distinctive pattern on dorsum of abdomen. On *Thuya occidentalis* ....**tujafilinus** (Del Guercio)
8. First joint of hind tarsus longer than one-fourth the second 10
— First joint of hind tarsus less than one-fourth the second 9
9. Third antennal segment without sensoria (fig. 94). Body robust, being of the usual *Lachnus* shape. Third discoidal twice-branched, only occasionally once-branched. On *Abies grandis* ....**occidentalis** Davidson
— Third antennal segment with several irregular sensoria (fig. 95). Body long and narrow, being somewhat the shape of *Essigella californica* (Essig). Third discoidal simple or once-branched. On *Pinus* sp. **pini-radiatae** Davidson
10. Cornicles very poorly developed, seemingly absent in some cases (fig. 103). Segment three of antennae with five-seven large circular sensoria which are hardly distinguishable (fig. 106). On *Pseudotsuga taxifolia.* **taxifolia** Swain
— Cornicles normal (fig. 97), being quite conspicuous. Third antennal segment with two–four clearly defined sensoria (fig. 101). On *Picea glehni.* **glehnus** Essig

45. **Lachnus ferrisi** Swain

Figures 89, 91

Davidson, Jour. Econ. Ent., vol. 2, p. 299, 1909. *Lachnus abietis* Fitch (list).

Davidson, Jour. Econ. Ent., vol. 3, p. 374, 1910. *Lachnus abietis* Fitch (list).

Essig, Pom. Jour. Ent., vol. 4, p. 773, 1912. *Lachnus abietis* Fitch (list).

Swain, Trans. Am. Ent. Soc., vol. 44, p. 9, 1918.

Records.—*Abies concolor*, Stanford University (Davidson); *Pinus* sp., Stanford University (Swain).

This large lachnid, recently described by the author, has been found only in the vicinity of Stanford University, in 1909 and 1910 by Davidson on lowland fir, and in 1915 by Ferris on some young pine trees. Since then it has not been observed.

46. **Lachnus glehnus** Essig

Figures 96, 97

Essig, Pom. Jour. Ent. Zool., vol. 7, pp. 180–187, 1915 (orig. desc.).

Record.—*Picea glehni*, Sacramento (Essig).

Essig described this species from specimens taken on a Japanese spruce in Capitol Park, Sacramento, in 1912. At the time it was so abundant that control measures were deemed necessary. The author has had access to the type specimens in Essig's collection.

47. **Lachnus occidentalis** Davidson

Davidson, Jour. Econ. Ent., vol. 2, p. 300, 1909 (orig. desc. apterae).

Davidson, Jour. Econ. Ent., vol. 3, p. 374, 1910 (list).

Essig, Pom. Jour. Ent., vol. 4, p. 773, 1912 (list).

Wilson, Can. Ent., vol. 44, p. 193, 1912 (desc. all forms).

Records.—*Abies grandis*, Stanford University (Davidson, Morrison, Ferris and the author); *Abies concolor*, Corvallis, Oregon (Wilson).

This species is practically always present on a lowland fir tree in the cactus garden of the Stanford University grounds. Wilson has found it in the vicinity of Corvallis, Oregon, on white fir. Davidson states that it is heavily preyed upon by the larvae of *Syrphus arcuatus* and *Syrphus opinator*.

48. **Lachnus oregonensis** Wilson

Wilson, Trans. Am. Ent. Soc., vol. 12, p. 103, 1915 (orig. desc.).

Record.—*Pinus contorta,* Oregon and California (Wilson).

There has been no published record of this species from California. Wilson wrote the author some time ago that he had taken it in this state, although he gave no definite locality. The author has never seen specimens.

49. **Lachnus pini-radiatae** Davidson

Figure 95

Davidson, Jour. Econ. Ent., vol. 2, p. 299, 1909 (orig. desc.).
Davidson, Jour. Econ. Ent., vol. 3, p. 374, 1910 (list).
Davidson, Pom. Jour. Ent., vol. 3, p. 398, 1911 (list).
Essig, Pom. Jour. Ent., vol. 4, p. 773, 1912 (list).
Essig, Pom. Jour. Ent., vol. 4, p. 785, 1912 (descriptive note).

Records.—*Pinus radiata,* Stanford University (Davidson), August, 1914, April, 1915 (author), March, 1916 (K. B. Brown); *Pinus ponderosa,* Bowman, Placer County, November, 1911 (H. H. Bowman), Berkeley, March, 1915 (Geo. Shinji); *Pinus sabiniana,* Penryn, Placer County (Davidson).

This is a fairly small, slender-bodied, long-legged lachnid found infesting the needles of various pines in the San Francisco Bay region and in the Sacramento Valley. They are easily recognized on the needles by the whitish mass of flocculence which covers their bodies.

50. **Lachnus ponderosa** Williams

Figure 104

Williams, Univ. Neb. Studies, vol. 10, p. 106, 1910 (orig. desc.).
Davidson, Jour. Econ. Ent., vol. 7, p. 127, 1914 (list).

Record.—*Pinus ponderosa* jeffreyi, Tallac, Eldorado County (Davidson).

Davidson's is the only report of this species in California. The identification of his specimens was verified by Davis. One specimen the author saw was quite small, being much smaller than the others taken by Davidson.

51. **Lachnus pseudotsugae** Wilson

Figures 92, 98

Wilson, Can. Ent., vol. 44, pp. 159, 302, 1912 (orig. desc.).

Record.—*Pseudotsuga taxifolia;* Oregon, California (Wilson).

Wilson wrote the author some time ago that he had taken this species in California, although he gave no definite locality or collection record. The author has had the opportunity to study cotype specimens.

52. **Lachnus sabinianus** n.sp.

Record.—Pinus sabiniana, San Francisco (Compere).

In March, 1915, Harold Compere of the California State Insectary found a small infestation of a species of *Lachnus* on Digger Pine in the Golden Gate Park, San Francisco. Since this one collection, the species has not again been observed. Being unable to identify the species with any described in America, a description is herewith appended, the species being named after its host plant, *Pinus sabiniana*. All the specimens, including the types are in the collections of E. O. Essig and of the University of California, Berkeley. The specimens were all mounted in Canadian balsam before color notes were taken, so those in the following description are only approximately correct.

Alate viviparous female.—Rich chestnut-amber to dark brown. Antennal segments I and II, amber; III, yellowish with tips darker; IV, V, and VI, dark yellow to dusky. Prothorax, chestnut-brown. Thoracic lobes very dark brown to black. Beak, pale with tips dusky. Cornicles, black. Cauda and anal plate with distal margins black. Femora, chestnut-brown with base amber; tibiae, brown with amber ring near the base; tarsi, amber. Wing veins, grayffi stigma, dusky gray.

Measurements: Body 4.2 mm. long and 1.7 mm. wide at thorax. Antennae reach to base of abdomen, without secondary sensoria. I, 0.10 mm.; II, 0.09 mm.; III, 0.50 mm.; IV, 0.25 mm.; V, 0.19 mm.; VI, 0.08 mm.; total, 1.21 mm. Beak reaches to the base of the cornicles. Cornicles medium sized and of the usual *Lachnus* shape, being

Apterous viviparous female.—Chestnut-brown in color with black dorsal spots on abdomen. Antennal segments I and II, dark; III, dusky yellow with tip dark; IV, V, and VI slightly darker. Beak reaches to the base of the cornicles. Coxae, black; femora, black with basal one-fifth paler; tibiae, black with pale ring near base; tarsi, black. Cornicles, black and conspicuous. They measure 5.2 mm. in length and 3.3 mm. in width.

53. **Lachnus taxifolia** Swain

Figures 99–103

Swain, Trans. Am. Ent. Soc., vol. 44, p. 11, 1918.

Records.—*Pseudotsuga taxifolia*, Sacramento (Essig), Berkeley and San Francisco (Shinji).

This is a fairly common species found in colonies on the branches and trunks of Douglas fir in the San Francisco Bay and Sacramento Valley. It is interesting particularly because of the atrophied cornicles.

54. **Lachnus tujafilinus** (Del Guercio)

Figures 93, 105

Del Guercio, Redia, vol. 5, p. 287, 1909. *Lachniella* (orig. desc.).
Essig, Pom. Jour. Ent., vol. 3, p. 541, 1911. *Lachnus juniperi* DeGeer (desc.).
Essig, Pom. Jour. Ent., vol. 4, p. 773, 1912. *Lachnus juniperi* DeGeer (list).
Davidson, Jour. Econ. Ent., vol. 7, p. 127, 1914 (list).

Records.—*Thuya occidentalis*, Claremont, Santa Paula (Essig); Palo Alto, Walnut Creek (Davidson); Stanford University, March, 1912 (Morrison); San Diego, March, 1916; Riverside, October, 1916, March, 1917.

This oddly marked *Lachnus* is more or less common throughout California wherever arborvitae is cultivated. The apterous females are the most common, and are easily recognized by the odd markings on the dorsum of the abdomen (see Essig's illustrations). Occasionally the alate females are found, Davidson finding some in April, Morrison and the author in March. The author has observed the larvae of *Coccinella californica* feeding on them in Riverside.

55. **Lachnus vanduzei** n.sp.

Figure 88

Records.—*Picea* sp., Berkeley, September, 1914 (Essig, E. P., Van Duzee).

In September, 1914, E. P. Van Duzee collected a few specimens of a large *Lachnus* on a species of spruce in Strawberry Canyon, near Berkeley. Later in the same month Essig found specimens on the same tree. The following fall the author hunted for the species, but was unable to find any specimens, the tree on which it was first found having been cut down. In the following description the color notes are not absolutely accurate, as they were taken from material mounted in balsam. This species is named after its first collector, Mr. E. P. Van Duzee, of the University of California. Type specimens are in the collection of the University of California.

Alate viviparous female.—The alate viviparous females are of a dark muddy color, as near as can be judged from the mounted specimens. The antennae are: I and II, dusky; III and IV, pale with apical half dusky; V, pale with the apex or apical third dusky; VI, pale with the apex and spur dusky. The measurements of the segments are: I, 0.09 mm.; II, 0.07 mm.; III, 0.5 mm.; IV, 0.26 mm.; V, 0.27 mm.; VI, 0.16 mm. The sensoria are located as follows: III, 10–12; IV, 2–3; V, 2-3; VI, 1. They are large and circular, and quite evenly distributed in a line on each segment. The beak reaches to the base of the cauda. The coxae are black, the femora amber on the basal half and black on the apical, the tibiae are black with an amber ring near the base, the tarsi are black. The first joint of the hind tarsus is not one-third the length of the second, the first measuring 0.08 mm., and the second 0.26 mm. The wings are quite large, with a very distinct stigma. The costal vein is grayish-brown, the subcostal brown. The stigma is long and brown, the stigmal vein being pale brown and slightly curved throughout its entire length. The first and second discoidals are distinct and pale brown, the second discoidal being slightly curved near the tip. The third discoidal is indistinct and twice-branched, the angles of the branches being very acute.

Apterous viviparous female.—Prevailing color, amber-brown, with the abdomen mottled gray, brown, and black. The head is brown with anterior margin amber. The antennae are colored as follows: I, amber; II, amber; III, amber with tip dusky; IV, amber with tip dusky; V, amber with apical two-thirds dusky; VI, dusky. The beak reaches to the base of the cauda. The femora are brown with the bases amber, the tibiae and tarsi brown. The first joint of the hind tarsus is scarcely more than one-third the length of the second. In four tarsi measured, the relative lengths of the joints were: 0.07 to 0.23 mm.; 0.08 to 0.23 mm.; 0.08 to 0.28 mm.; and 0.07 to 0.25 mm. The cornicles are conspicuous and dark, the cauda well rounded and dark on its posterior edge. The lengths of the antennal segments are: I, 0.1 mm.; II, 0.1 mm.; III, 0.56 to 0.57 mm.; IV, 0.21 to 0.23 mm.; V, 0.22 to 0.28 mm.; VI, 0.15 to 0.16 mm.

Group **Aphidina** Wilson

Wilson, Ann. Ent. Soc. Am., vol. 3, p. 314, 1910.

This group as considered by Wilson consists of three tribes: Trichosiphini, Macrosiphini, and Aphidini. The first of these contains two genera found only in the Asiatic islands, so it will not be considered in this paper. This group contains quite closely related genera, and in many cases it is quite hard to distinguish between them. Following is a brief extract from Wilson's paper (cited above):

> In studying closely related genera the development of the external characters may be placed in five divisions: (1) the antennae and spur; (2) the antennal tubercles; (3) the development of the nectaries [cornicles]; (4) the development of the cauda; (5) the development of the wing venation. In a group of insects as pliable as the present one, any one or two of these characters may be either under- or over-developed and it is necessary to place the genera according to the greatest development. Of all the characters which show this variation the wings show what may be true of all these characters.

The two tribes have been separated from one another on the character of the antennal tubercles, as Wilson says in the same paper:

> The division is made between species with distinct antennal tubercles and those having none or at the most indistinct tubercles. However, should a certain species have distinct antennal tubercles with the other characters [of the *Macrosiphini*] wanting, then it would have to go into the next tribe [*Aphidini*].

The keys to the tribes and genera below have been formulated by the author, following, however, those of Wilson, Van der Goot, and Mordwilko.

1. Antennal tubercles well formed. Antennae usually as long as or longer than the body. Apterae often with sensoria on the third antennal segment. Body never with lateral tubercles on the seventh abdominal segment. Cornicles variable but usually about one-fourth the length of the body or longer .... Tribe **Macrosiphini**

— Antennal tubercles absent or more or less indistinct. Antennae seldom longer than the body. Apterae seldom with sensoria on the third antennal segment. Body with lateral tubercles on at least the seventh abdominal segment .... Tribe **Aphidini**

Tribe **Macrosiphini** Wilson

Wilson, Ann. Ent. Soc. Am., vol. 3, p. 314, 1910.

To a large extent the author has followed Wilson in the placing of the genera, but in a few cases he has not. This is noticeable in *Toxoptera,* which is considered by Wilson as belonging to this tribe, while the author feels that it is better associated with the Aphidini, inasmuch as the antennal tubercles are very small and more or less indistinct and as the antennae are scarcely as long as the body. Van der Goot's genus, *Myzaphis*, has been accepted for the two species, *Myzus rosarum* (Walker) and *Aphis abietina* Walker, and is included with the Aphidini. The species *Aphis nymphaeae* Linn., which Wilson uses as the type of *Rhopalosiphum*, has been taken from this genus and placed in *Siphocoryne*, chiefly because of the apparent absence of antennal tubercles and of the presence of distinct tubercles on the seventh abdominal segment. Therefore *Aphis persicae* Sulzer takes the place as type of the genus *Rhopalosiphum*.

KEY TO CALIFORNIA GENERA

1. Cornicles cylindrical, or at most but very slightly swollen on one side (figs. 122, 152) 4

— Cornicles distinctly swollen toward apex, or clavate (figs. 109, 113, 119) 2

2. Antennal tubercles very large and tapering but not gibbous on the inner side; the bases of the antennae being more or less approximate (fig. 107). **Nectarosiphon** Schouteden

— Antennal tubercles distinct, but not large and tapering as above, being more or less toothed or gibbous on the inner side; the bases of the antennae not approximate (figs. 108, 111) 3

3. Antennal tubercles short and wedge-shaped, the outer side not evident (fig. 108). Cauda ensiform and of medium size. Antennae at most but slightly longer than the body .... **Rhopalosiphum** Koch

— Antennal tubercles short, but not wedge-shaped (fig. 111). Antennae considerable longer than the body. Cauda very large and long. **Amphorophora** Buckton

4. Antennal tubercles large and as long on the outer as on the inner side (fig. 106) 5

— Antennal tubercles with outer side shorter than inner, or not evident (figs. 112, 115, 116) 7

5. Cornicles tapering, longer than cauda which is ensiform (fig. 152). Wing venation regular, with third discoidal twice-branched. **Macrosiphum** Passerini

— Cornicles and cauda variable. Wing venation irregular and very striking with veins either wanting or combined, and shaded 6

6. Antennal tubercles with short upper inner angle. Cauda shorter than cornicles and tapering. Stigmal and third discoidal veins meet in a broad dark band, giving the wing the appearance of having a closed triangular cell (fig. 110) .... **Idiopterus** Davis

— Antennal tubercles with small rounded tubercle at the upper inner angle. Cornicles slightly constricted in the middle and at the tip. Wing venation variable, but usually the stigmal and third discoidal veins are partly joined and form a distinct, closed, four-sided cell .... **Pentalonia** Coquerel

7. Antennal tubercles and first antennal segment with a strong tooth on the inner side of each (figs. 115, 116). Cauda short and tapering (fig. 118). Cornicles cylindrical and tapering slightly with tip outcurved (fig. 117). **Rhorodon** Passerini

— Antennal tubercles with a distinct but not prominent blunt projection forming the inner angle (fig. 112), but the prominent teeth as above are lacking. Cauda short, tapering, and usually triangular (fig. 121). Cornicles as above, being cylindrical, with a slight tapering from base to apex, and often slightly outcurved at tip (fig. 122) .... **Myzus** Passerini

21. Genus **Amphorophora** Buckton

Buckton, Monog. Brit. Aphides, 1876. Type *A. ampullata* n.sp.

KEY TO CALIFORNIAN SPECIES[9]

Cornicles pale, or at most slightly dusky, swollen and vasiform (fig. 113). VI spur longer than III, the latter with 35–45 sensoria .... **rubi** (Kalt.)

Cornicles black, greatly dilated in apical one-half (fig. 161). VI spur shorter than III, latter with 13–17 sensoria .... **latysiphon** Davidson

56. **Amphorophora latysiphon** Davidson

Figure 161

Davidson, Jour. Econ. Ent., vol. 5, p. 408, 1912 (orig. desc.).

Records.—*Vinca major*, San Jose (Davidson); Courtland, Contra Costa County (Davidson); Stanford University, 1912 (Morrison, Essig). *Convolvulus arvensis*, San Jose (Davidson). *Solanum tuberosum*, Walnut Creek, Contra Costa County, 1915 (Davidson).

This species has been found sparingly in the San Francisco Bay region on periwinkle, morning-glory, and potato tubers, although it has never seemed to be common. The author has not collected it, his only specimens being some taken by Essig on periwinkle near Stanford University. The odd shape of the cornicles is a distinguishing character.

57. **Amphorophora rubi** Kalt.

Figures 111, 113, 162

Kaltenbach, Monog. d. Pflanzenläuse, p. 23, 1843. *Aphis* (orig. desc.).
Davidson, Jour. Econ. Ent., vol. 5, p. 411, 1912 (list).
Shinji, Can. Ent., vol. 49, p. 52, 1917 (list).

Records.—*Rubus parviflorus*; San Jose (Davidson): *Rubus* spp., Walnut Creek, 1915 (Davidson); Berkeley (Shinji).

This species has been taken a few times on thimble-berry in the San Francisco Bay region. Davidson writes that he has also found it on blackberry and loganberry in the vicinity of Walnut Creek,

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[9] G. O. Shinji (Can. Ent., vol. 49, p. 51, 1917) described an aphid from *Cicuta virosa* var. *californica* in Berkeley, which he called *Amphorophora cicutae* n.sp. The author has never seen specimens, so does not feel that he can recognize this as a good species. Of some half dozen new (?) species described by Shinji the author has found none, on examining specimens, that are good species, hence he cannot recognize this one at present.

Contra Costa County. The author has recently received specimens from Gillette of an alate viviparous female and apterous oviparous females taken in the vicinity of Fort Collins, Colorado. Inasmuch as the descriptions of this species are inadequate and not readily accessible it has been thought best to give here brief descriptions of the different forms. As no color notes were received with the specimens they must necessarily be omitted.

Alate viviparous female (from Fort Collins, Colorado).—Antennae half as long again as the body, dusky, and placed on small but distinct tubercles. From the mounted material it appears as if III were dusky, IV, pale with extreme tip dusky; V, pale with apical one-third dusky; and VI dusky. VI spur is the longest segment, followed by III, IV, V, VI base, I, and II. The usual primary and accessory sensoria are present on VI base, and the primary sensorium on V. Secondary sensoria are present only on III. These are small, circular, irregular-sized, and irregularly placed along the whole length of the segment. . The number (35 to 40) is such as to make the segment appear tuberculate. The beak is quite large and long, reaching to or slightly beyond the third coxae. The thorax is dusky. The wings fairly large, and normal. The second branch of the third discoidal vein arises nearer to the base of the first branch than to the apex of the wing. Normally the measurements are as follows: From the base of the second branch of the third discoidal to the tip of the wing is about 0.8 mm., from the base of the first branch to the base of the second 0.4 mm., from the apex of the first branch to the apex of the second 0.29 mm. In one case the base of the second branch was 1.02 mm. from the apex of the wing, and but 0.034 mm. from the base of the second, while the apices of the two branches were but 0.187 mm. apart. The legs are long, femora pale with apical one-fourth dusky, tibiae and tarsi dusky. The abdomen is pale with some slight dorsal dark markings, these being indistinct in the mounted specimens. The cornicles are fairly long, clavate on the apical one-half or two-thirds, dusky throughout, and with the extreme tip reticulated. In length they are somewhat shorter than III, but longer than IV. The cauda is pale, short, and triangular, being about equal in length to the hind tarsi.

Measurements: body length, 1.785 mm.; antennae total, 2.788 mm.; III, 0.68 mm.; IV, 0.51 mm.; V, 0.408 to 0.425 mm.; VI, base, 0.12 mm.; VI, spur, 0.867 to 0.884 mm.; cornicles, 0.578 to 0.646 mm.; cauda, 0.102 mm.; hind tarsi, 0.102 mm.; wing length, 3.128 mm.; width, 1.292 mm.; expansion, 6.8 mm.

Apterous oviparous female (Fort Collins, Colorado).—Pale throughout, with many small hairs scattered over the body. Most of these hairs are simple, but some especially on the front of the head and on the bases of the antennae, are capitate. Antennae slightly longer than the body, pale, with VI and the apices of the other segments dusky. VI spur and III are subequal or either one may be slightly longer than the other. These are followed by IV, V, VI base, I, and II. The usual primary and accessory sensoria are present on VI base, and the primary sensorium of V. Secondary sensoria are present only on III, and number about nine or ten. These are small, circular, but varying in size, and are arranged in a more or less even line along the basal one-half to two-thirds of the segment. Beak pale, with tip dusky, quite large and long, reaching to or beyond the third coxae. Thorax and legs normal, except the hind tibiae which are quite long, and furnished with a large number of sensoria. These sensoria cover practically the whole joint. Cornicle very long and large, curved outward, pale, with apex dusky, and with distinct reticulations at the extreme tip. They are markedly larger than in the alate viviparous females, being considerably longer than the third antennal segment, and in some cases even half as long again. The cauda is small, pale, and triangular, although somewhat larger in the viviparous female.

Measurements: body length, 2.04 mm.; width of thorax, 0.595 mm.; antennae total, 2.446 mm.; III, 0.646 to 0.697 mm.; IV, 0.442 to 0.459 mm.; V, 0.356 to 0.374 mm.; VI, base, 0.136 mm.; VI, spur, 0.663 mm.; cornicles, 0.918 to 0.952 mm.; cauda, 0.187 mm.; hind tarsi, 0.136 mm.

22. Genus **Idiopterus** Davis

Davis, Ann. Ent. Soc. Am., vol. 2, p. 198, 1909. Type, *I. neprelepidis* n.sp.

58. **Idiopterus nephrelepidis** Davis

Figure 110

Davis, Ann. Ent. Soc. Am., vol. 2, p. 198, 1909 (orig. desc.).
Davidson, Jour. Econ. Ent., vol. 3, p. 376, 1910 (list).
Essig, Pom. Jour. Ent., vol. 3, p. 538, 1911 (list).

Records.—*Nephrolepis exaltata*, Santa Paula (Essig), Palo Alto, April, 1915, San Diego, March to May, 1916; Riverside, February, 1917: *Cyrtonium fulcatum*, Berkeley, March, 1915 (Essig); ferns (unidentified species of house ferns), Stanford University (Davidson, Morrison); *Viola* sp., Claremont (Essig).

This small black aphid is often found in houses and nurseries, and occasionally out of doors, on the fronds of various kinds of house ferns, particularly the Boston fern. Essig has also found it on violets in the vicinity of Pomona College. The alate females have the wings beautifully marked with black and white.

23. Genus **Macrosiphum** Passerini

Passerini, Gli Afidi, 1860. Type *Aphis rosae* Linn.

Key to California Species

Alate viviparous females

1. Cornicles slightly clavate on one side, somewhat as in *Rhopalosiphum*. **tulipae** (Monell)
— Cornicles not clavate 2
2. III as long as V and VI (base and spur) .... **sonchella** (Monell)
— III not as long comparatively 3
3. III pale, IV, V, and VI dusky .... **jasminum** (Clarke)
— Not so; if IV, V, and VI are dusky then III is also, except perhaps the base; or if III is pale throughout then at least the greater part of IV and V are also pale 4
4. VI (base and spur) shorter than III, but V and VI together are longer than III .... **baccharadis** (Clarke)
— VI (base and spur) not shorter than III 5
5. Secondary sensoria on III, IV, and V. Cornicles not reticulated. **heucherae** (Oestlund)
— No secondary sensoria on V 6
6. Secondary sensoria on both III and IV. Cornicles with tips at least reticulated (fig. 152) 7
— No secondary sensoria on IV 10
7. Cornicles and cauda subequal in length, the former being more or less bottle-shaped .... **sanborni** Gillette
— Cornicles longer than cauda 8
8. Cauda light green. Secondary sensoria only occasionally present on IV and then very small and indistinct .... **rosae** (Linn.)
— Cauda dark (brown or black). Seven or more distinct secondary sensoria on IV 9
9. Body with capitate setae, especially on head and antennae. **artemisiae** (Fonsc.)
— Body without capitate setae. Abdomen with dark dorsal markings. **lactucae** (Kalt.)
10. Cornicles with at least tips reticulated (fig. 132) 14
— Cornicles with no reticulations (fig. 156) 11
11. Body with fan-shaped setae .... **artemisicola** (Williams)
— Body without fan-shaped setae 12
12. Distal two-thirds of cornicles black .... **orthocarpus** (Dvdn.)
— Only tip of cornicles black 13
13. Cornicles long and slender. About 18 secondary sensoria in a row on III (fig. 130) .... **pisi** (Kalt.)
— Cornicles shorter and heavier. About 25 to 30 sensoria scattered irregularly along III (fig. 157) .... **dirhodum** (Walker)
14. Cornicles with more than apical one-half reticulate (fig. 149). **ludovicianae** (Oestlund)
— Cornicles with less than apical one-half reticulated (fig. 128) 15

15. Cornicles dusky for practically their entire length 20
— Cornicles with less than apical one-half dusky 16
16. Cornicles considerably longer than III, with apical portion curved outward. About a dozen, medium-sized sensoria in a straight line along basal two-thirds of III (fig. 131) ..... **californicum** (Clarke)
— Cornicles not considerably longer than III 17
17. Cornicles and VI spur subequal, the former fairly long, slightly curved outward and slightly swollen before the tip (fig. 128) ..... **stanleyi** Wilson
— Cornicles considerably shorter than VI spur, and not swollen before the tip 18
18. Secondary sensoria in a fairly straight line on III. Body not pulverulent 19
— Body covered with a slight pulverulence. III with about 30 fairly large-sized sensoria, more or less scattered along the entire length (fig. 143). **albifrons** Essig
19. Cornicles about half the length of VI spur and considerably shorter than III, the latter with about 20 to 30 secondary sensoria ..... **pteridis** Wilson
— Cornicles about two-thirds as long as VI spur and slightly shorter than III, the latter with about 15 sensoria (fig. 133) ..... **cucurbitae** (Thomas)
20. Ground or basal color of abdomen green 21
— Ground or basal color of abdomen red, brown, or black 24
21. Cornicles green, sometimes dusky at apex ..... **solanifolii** (Ashmead)
— Cornicles black 22
22. III with a small number (9–15) of secondary sensoria on basal one-half (fig. 135); longer than VI spur ..... **granarium** (Kirby)
— III with some 30 or more sensoria scattered along its entire length (figs. 151, 159); subequal to or shorter than VI spur 23
23. Cornicles and III subequal. Tibiae with apices only dusky ..... **rosae** (Linn.)
— Cornicles longer than III. Tibiae dusky throughout. **rudbeckiae** (Fitch) n.var. **madia**
24. Cauda pale 25
— Cauda dusky 27
25. III and VI spur subequal ..... **rosae** (Linn.)
— III shorter than VI spur 26
26. Cauda about one-half as long as cornicles, the latter shorter than IV. **chrysanthemi** (Oestlund)
— Cauda slightly more than one-half as long as cornicles, the latter equal to or longer than IV ..... **rudbeckiae** (Fitch)
27. III and VI spur subequal 28
— III longer than VI spur ..... **taraxici** (Kalt.)
28. Body yellowish-brown in color; legs same except tarsi and tips of tibiae and femora which are dusky to black ..... **valerianae** (Clarke)
— Body dark reddish-brown to black in color; legs dusky throughout. **ambrosiae** (Thomas)

Apterous viviparous females[10]

1. Cornicles clavate on one side, somewhat as in *Rhopalosiphum*. **tulipae** (Monell)
— Cornicles not so, being cylindrical or subcylindrical 2

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[10] Only the species of which there are specimens available to the author, or of which there are adequate descriptions, are included in this key. The species represented in the author's collection are marked with an asterisk (*). The author recognizes the great difficulty in separating the apterae of various species, particularly in this genus, and offers this key merely as a slight aid toward the recognition of the better known species.

2. III without or at most with only a few secondary sensoria (0–12) 11

— III with several (over 12) secondary sensoria scattered along the greater part of its length 3

3. Cornicles short and tapering, being somewhat bottle-shaped and not distinctly longer than the cauda ....**sanborni** Gillette*

— Cornicles normal, being cylindrical and considerably longer than the cauda 4

4. III and IV with secondary sensoria ....**heucherae** (Oestlund)

— IV without secondary sensoria 5

5. General body color dark, being red, wine, brown or black 6

— General color lighter, usually being a shade of green 8

6. Cauda black. Legs black, except the bases of the femora ......**taraxici** (Kalt.)

— Cauda pale. Legs with at least the bases of the femora and tibiae not black 7

7. Legs green, except tarsi and apices of femora and tibiae. Cauda not more than half the length of the cornicles. Not more than ten to twelve sensoria on the basal one-third of III ....**rosae** (Linn.)*

— Legs black, except bases of femora and tibiae, which are light brown. Cauda more than half the length of the cornicles. A considerable number of sensoria scattered over more than the basal one-half of III.
rudbeckiae (Fitch)*

8. Cornicles subequal to or shorter than III. Body covered with a whitish pulverulence 9

— Cornicles distinctly longer than III. Body without whitish pulverulence 10

9. Cornicles, except tip, and cauda green; the former subequal in length to III and about twice as long as cauda ....**albifrons** Essig*

— Cornicles black, cauda yellow or light brown; the former considerably shorter than III and not twice as long as cauda ....**ludovicianae** (Oestlund)*

10. Cauda quite broad and blunt at end. Cornicles with not more than apical one-sixth reticulated ....**rosae** (Linn.)*

— Cauda slender and pointed. Cornicles with apical one-fourth reticulated.
rudbeckiae (Fitch) n.var. **madia***

11. Body covered with capitate or fan-shaped setae 12

— Body without specialized setae 14

12. Setae with fan-shaped tips and thickly covering the body. Cornicles slender and imbricated for their entire length ....**artemisicola** (Williams)*

— Setae capitate and only sparsely covering body 13

13. Cornicles fairly stout, with tips reticulated, and about twice as long as cauda.
artemisiae (Fonsc.)

— Cornicles slender, with no reticulations, and considerably more than twice the length of the cauda ....**pteridis** Wilson

14. Cornicles with tips at least reticulated 16

— Cornicles with no reticulations 15

15. Cornicles very long and slender. Antennae considerably longer than body.
pisi (Kalt.)*

— Cornicles shorter and heavier. Antennae at most but slightly longer than body ....**dirhodum** (Walker)*

16. Cornicles for the most part dusky or black 17

— Cornicles mostly pale or green 19

17. Cornicles and III subequal. Body not pulverulent 18

— Cornicles considerably shorter than III. Body more or less pulverulent.
ludovicianae (Oestlund)*

18. III with but two or four sensoria near base; longer than VI spur. **granarium** (Kirby)*
— III with six or so sensoria on basal one-half; shorter than or equal to VI spur .... **rosae** (Linn.)*
19. Cornicles longer than III 20
— Cornicles at most subequal to III 21
20. Antennae pale, except VI and the apices of III to V. Cornicles slightly swollen near distal end .... **stanleyi** Wilson*
— Antennae dusky, except III, basal part of IV, and perhaps the extreme base of V. Cornicles long, slender, and out-curved .... **californicum** (Clarke)*
21. Cauda broad, and blunt, with the sides almost parallel and about half as long as cornicles .... **lactucae** (Kalt.)*
— Cauda slender-pointed, and more than half as long as cauda 22
22. VI spur and III subequal .... **solanifolii** (Ashmead)*
— VI spur considerably longer than III .... **cucurbitae** (Thomas)*

59. **Macrosiphum albifrons** Essig

Figures 143, 144

Davidson, Jour. Econ. Ent., vol. 2, p. 304, 1909. *Macrosiphum* sp. (list).
Essig, Pom. Jour. Ent., vol. 3, p. 543, 1911 (orig. desc.).

Records.—*Lupinus* sp., Santa Paula (Essig); Stanford University (Davidson); Jasper Ridge, Coast Range Mountains, Santa Clara County, April, 1912 (V. G. Stevens); Berkeley, April, 1915 (Geo. Shinji); Mount Hood, Oregon, August, 1916 (E. A. McGregor).

This large, flocculent aphid is found occasionally infesting various lupines throughout the Pacific Coast, from southern California north, well into Oregon. The author has specimens from Berkeley and Oregon, although he has never collected it himself.

60. **Macrosiphum ambrosiae** (Thomas) ?

Thomas, Ill. Lab. Nat. Hist., Bull. 2, p. 4, 1878. *Siphonophora* (orig. desc.).
Sanborn, Kans. Univ. Sci., Bull. 3, p. 74, 1904 (desc.).

Records.—*Helianthus annuus;* Orange (T. D. A. Cockerell); San Diego, April, 1916.

In 1915 the author received a few specimens of this species from T. D. A. Cockerell from Orange, and in 1916 he collected it once on sunflower in Exposition Park, San Diego. At first it was thought to be *M. sonchi* (Linn.), and was so reported by Cockerell. Since then it was identified by J. J. Davis as probably *M. ambrosiae* (Thomas).

61. **Macrosiphum artemisiae** (Fonsc.)

Figures 142, 145

Boyer de Fonscolmbe, Ann. Ent. Soc. France, vol. 10, p. 162, 1841. *Aphis* (orig. desc.).
Essig, Pom. Jour. Ent., vol. 3, p. 546, 1911. *Macrosiphum frigidae* (Oest.) (desc.).
Davidson, Jour. Econ. Ent., vol. 3, p. 133, 1914. *Macrosiphum frigidae* (Oest.) (list).
Wilson, Trans. Amer, Ent. Soc., vol. 41, p. 97, 1915 (desc.).

Records.—Artemisia californica; Santa Paula (Essig); Walnut Creek, Contra Costa County (Davidson).

Occasionally this species is found infesting the tender shoots of the common California sage brush. It is characterized by the presence of capitate hairs scattered sparsely over the body, particularly of the apterous female. The synonomy above is after Wilson, who lists *M. frigidae* (Oestlund) as a synonym of *artemisiae* (Fonsc.).

62. **Macrosiphum artemisicola** (Williams)

Figures 146, 147

Williams, Univ. Neb. Studies, vol. 10, p. 73, 1910. *Siphonophora* (orig. desc.).
Wilson, Trans. Am. Ent. Soc., vol. 41, p. 96, 1915 (desc.).

Records.—Artemisia tridentata, A. vulgaris; Oregon (California) (Wilson).

Although there is no published record of the presence of this species in California it is included here on Wilson's authority. He stated to the author that he had found it in California, although he failed to give any date or locality record. This is characterized by the fan-shaped setae which thickly cover the body of the apterae, and which are present on the ventral side of the abdomen of the alates. The author has specimens taken by R. W. Haegele in the summer of 1915 on *Artemisia* sp. near Canton, Montana.

63. **Macrosiphum baccharadis** (Clarke)

Clarke, Can. Ent., vol. 35, p. 254, 1903. *Nectarophora* (orig. desc.).

Record.—Baccharis sp., Berkeley (Clarke).

This species is one of those described by Clarke, but since then unknown. It is possible that it is *M. rudbeckiae* (Fitch), which is so common on *Baccharis* throughout California.

64. **Macrosiphum californicum** (Clarke)

Figures 131, 132

Clarke, Can. Ent., vol. 35, p. 254, 1903. *Nectarophora* (orig. desc. apterae).
Davidson, Jour. Econ. Ent., vol. 2, p. 304, 1909 (list).
Davidson, Jour. Econ. Ent., vol. 3, p. 380, 1910 (list).
Davidson, Pom. Jour. Ent., vol. 3, p. 398, 1911 (list).
Essig, Pom. Jour. Ent., vol. 3, p. 548, 1911. *M. laevigatae*, n.sp. (orig. desc.).

Records.—*Salix* sp.; Newcastle, Placer County (Clarke); Stanford University and Penryn, Placer County (Davidson); Stanford University, November, 1914 (Morrison), May, 1915; Berkeley, April, 1915 (Shinji); August, 1915, *Salix laevigata;* Santa Paula (Essig); Riverside, May, 1917.

Clarke described the apterous females of a species of *Nectarophora* (*Macrosiphum*) from specimens taken on willow in Placer County. Because of the extremely long cornicles it is possible to identify this with specimens taken since throughout the San Francisco Bay region on various species of willows. Essig's *M. laevigatae* from Santa Paula is the same species, having been compared by the author with specimens from Stanford University and Berkeley. Morrison has taken the males and oviparous females of this species in the vicinity of Stanford University in November, 1914. The author has reared specimens of *Aphidius polygonaphis* Fitch, and *Praon simulans* Prov. from this species taken in Berkeley.

65. **Macrosiphum chrysanthemi** (Oest.)

Oestlund, 14th Rep. Geol. Surv. Minn., vol. 22, 1886. *Siphonophora* (orig. desc.).
Davidson, Jour. Econ. Ent., vol. 5, p. 411, 1912 (list).

Record.—Undetermined species of *Compositae;* Courtland (Davidson).

This is a doubtful species taken by Davidson at one time from an undetermined composite near Courtland. The author is entirely unacquainted with the species.

66. **Macrosiphum cucurbitae** (Thos.)

Figures 133, 134

Thomas, 8th Ann. Rep. Illinois St. Ent., p. 66, 1879. *Siphonophora* (orig. desc.).

Record.—*Cucurbita* sp., Hayward, Alameda County, July, 1915 (Roy E. Campbell); Los Angeles, May, 1917.

In July, 1915, Roy E. Campbell of the Bureau of Entomology, sent the author specimens of a *Macrosiphum* sp. from squash in Hayward. In 1917 the author found the same species abundantly on squash in Los Angeles. These the author identified as being specimens of *M. cucurbitae* (Thomas). Later J. J. Davis verified the determination. This is a new record for California. As the available descriptions of this species are quite inadequate, the author gives herewith a few descriptive notes taken from these specimens.

Alate viviparous female.—Antennae longer than the body, placed on distinct frontal tubercles, dusky except I, II, and extreme base of III. The spur of VI is the longest segment, followed by III, which is about four-fifths as long. IV and V are subequal, and almost as long as III. The usual primary and accessory sensoria are present on V and VI. Secondary sensoria are present on III (fig. 133), being small, circular, numbering about 14 to 15, and arranged in a fairly even row along the whole length of the segment. Beak pale with dusky tip, reaching to the second coxae. Thorax and abdomen green, the thoracic lobes not conspicuously darkened. Cornicles (fig. 134) green with apical one-third dusky, equal to or slightly longer than III, imbricated with tip reticulated. Cauda large, pale, vasiform, slightly more than half the length of the cornicles, reaching to their apices. Wings and legs normal.

Measurements: Body length, 2.3 mm.; antennae total, 3.25 to 3.35 mm.; III, 0.685 to 0.714 mm.; IV, 0.629 to 0.646 mm.; V, 0.603 to 0.612 mm.; VI, base, 0.136 to 0.153 mm.; VI, spur, 0.935 to 0.696 mm.; cornicles, 0.714 to 0.731 mm.; cauda, 0.408 mm.

67. **Macrosiphum dirhodum** (Walker)

Figures 156, 157

Walker, Ann. Nat. Hist., (2), vol. 3, p. 43, 1848. *Aphis* (orig. desc.).
Theobald, Jour. Econ. Biol., vol. 8, p. 128, 1913 (desc.).
Patch, Maine Agr. Exp. Sta., Bull. 233, p. 268, 1914 (note).
Gillette, Jour. Econ. Ent., vol. 8, p. 103, 1915 (note).

Record.—Rose, Santa Ysabel (3000 feet altitude), San Diego County, May, 1916; Riverside, April, 1917.

The author found this species sparingly on rose near Santa Ysabel, San Diego County, in May, 1916, and again in April, 1917, in Riverside. According to Gillette, this species passes the winter on rose, and the summer on various grains and grasses, as *M. rosae* (Linn.)

may do. These are the only records of it in California. The author has compared it with specimens taken by R. W. Doane in 1915 on grain in Utah.

68. **Macrosiphum granarium** (Kirby)

Figures 135, 148

Kirby, Linn. Soc. Trans., vol. 4, p. 238, *Aphis* (orig. desc.).
Davidson, Jour. Econ. Ent., vol. 5, p. 411, 1912 (list).
Theobald, Jour. Econ. Biol., vol. 8, p. 58, 1913 (desc.).
Davidson, Mon. Bull., Cal. Comm. Hort., vol. 6, p. 65, 1917 (note).

Records.—*Graminaceae* (various species); San Jose (Davidson); Stanford University, January to May, 1915; Berkeley, March, 1915: *Typha latifolia* (Davidson).

This is a more or less common species of *Macrosiphum* on various grains and grasses in the San Francisco Bay region during the winter and spring. In late spring and early summer, as the grasses begin to dry out, it leaves them for the cat-tail rush or California tule (Davidson, 1917). In the late fall or early winter it returns to the grains and grasses, where it passes the winter in the viviparous forms.

69. **Macrosiphum heucherae** (Thomas)

Thomas, 8th Ann. Rep. Illinois St. Ent., p. 66, 1879. *Siphonophora* (orig. desc.).
Davidson, Jour. Econ. Ent., vol. 8, p. 427, 1915 (desc.).

Record.—*Heuchera hartwegi,* Redwood Canyon, Contra Costa County (Davidson).

In the latter part of May, 1914, Davidson found all the forms, including the apterous and alate viviparous females, the apterous oviparous females, the alate males, and eggs on the flower stalks of alum root in Contra Costa County. Since his description no record has been made concerning the species. The author is unacquainted with it, having never seen specimens.

70. **Macrosiphum jasmini** (Clarke)

Clarke, Can. Ent., vol. 35, p. 252, 1903. *Nectarophora* (orig. desc.).

Record.—Jessamine, Berkeley (Clarke).

Since Clarke's description of the apterous viviparous females of this species it has never been found. Its identity is, therefore, unknown to the author.

71. **Macrosiphum lactucae** (Kalt.)

Kaltenbach, Monog. d. Pflanzenläuse, p. 199, 1857. *Nectarophora* (orig. desc.).
Sanderson, Can. Ent., vol. 33, p. 69, 1901. *Nectarophora* (desc.).
Essig, Univ. Calif. Publ., Entom., vol. 1, p. 328, 1917 (list).

Record.—*Cicorium intybus*, Rutherford, Napa County, 1916 (Essig).

This species has been taken only by Essig on chicory in Napa County during June, 1916. As its determination is doubtful the author gives herewith a brief description of the alate female.

Body pale to green, with the following parts more or less dusky: head, antennae, prothorax, thoracic lobes, apex of beak, tarsi, apical one-fifth to one-fourth tibiae, apical one-half femora, cornicles, anal plate, marginal spots on the abdominal segments, submarginal spots of the second and third abdominal segments, dorsal bands on the fourth and fifth, and the dorsum of the remaining abdominal segments. Eyes red.

The antennal tubercles are prominent and project rectangularly inward. A prominent frontal tubercle is present on the apex. The antennae are about half as long again as the body. The usual primary and accessory sensoria are present. On III there are from thirty-five to forty-five circular secondary sensoria; on IV from five to fifteen secondary sensoria. These two segments appear tuberculate. The beak reaches beyond the second coxae. The cornicles are longer than the cauda, and subequal in length to the fourth antennal segment. They are subcylindrical and fairly stout. The cauda is long and ensiform, reaching to the tip of the cornicles. The wings and venation are normal.

Measurements (of three specimens): Body length, 1.836 to 1.955 mm.; width of thorax, 0.765 to 0.833 mm.; antennae, total, 2.805 to 2.992 mm.; III, 0.680 to 0.697 mm.; IV, 0.441 to 0.527 mm.; V, 0.391 to 0.425 mm.; VI, base 0.085 to 0.119 mm.; VI, spur 0.952 to 1.105 mm.; cornicles, 0.441 to 0.493 mm.; cauda, 0.238 to 0.272 mm.; hind tarsi, 0.136 to 0.153 mm.; wing, length, 3.145 to 3.315 mm.; width, 0.952 to 1.139 mm.; expansion, 7.36 to 7.87 mm.

72. **Macrosiphum ludovicianae** (Oestlund)

Figures 136, 148

Oestlund, Minn. Geol. Nat. Hist. Surv., vol. 14, p. 23, 1886. *Siphonophora* (orig. desc.).
Davidson, Jour. Econ. Ent., vol. 7, p. 136, 1914 (list).
Wilson, Trans. Am. Ent. Soc., vol. 12, p. 98, 1015 (desc.)

Records.—*Artemisia heterophylla;* Walnut Creek, Contra Costa County (Davidson), Berkeley, 1915 (Shinji); *Artemisia dracunculoides, Convolvulus* sp., *Stachys bullata,* Berkeley, 1915 (Shinji).

This species is quite common in the San Francisco Bay region on various species of sagebrush. George Shinji has taken it also on hedge-nettle and bindweed in Berkeley. It is distinguished from other sage-infesting species of *Macrosiphum* by the fact that the body of the apterous females is covered with pointed setae as opposed to the fan-shaped setae of *M. artemisicola* (Williams), and the capitate setae of *M. artemisiae* (Fonsc.).

73. **Macrosiphum orthocarpus** Davidson

Davidson, Jour. Econ. Ent., vol. 2, p. 304, 1909 (orig. desc.).
Davidson, Jour. Econ. Ent., vol. 3, p. 380, 1910 (list).

Record.—*Orthocarpus purpurascens;* Stanford University (Davidson).

Since Davidson found the specimens on owl-clover from which he described this species, it has not again been taken.

74. **Macrosiphum pisi** (Kalt.)

Figures 130, 150

Kaltenbach, Monog. d. Pflanzenläuse, p. 23, 1843. *Aphis* (orig. desc.).
Davidson, Jour. Econ. Ent., vol. 2, p. 304, 1909 (list).
Davidson, Jour. Econ. Ent., vol. 3, p. 380, 1910 (list).
Essig, Pom. Jour. Ent., vol. 2, p. 336, 1910. *Nectarophora* (desc.).
Branigan, Mon. Bull. Cal. Comm. Hort., vol. 4, p. 285, 1915. *M. destructor* (Johnson) (list).
Davis, U. S. Dept. Agr., Bull. 276, p. 11, 1915 (list).

Records.—*Pisum sativum;* Claremont, Santa Ana, and Ventura (Essig); Alameda County (Brannigan); El Cajon, San Diego County, May, 1916: *Lathyrus odoratus;* Stanford University (Davidson, Morrison); San Diego, October, 1916: *Viola* sp.; Claremont, Santa Ana, Ventura (Essig); *Medicago* sp.; Holtville, Imperial County (V. L. Wildermuth): *Psorales macrostachya;* Santa Paula (Essig).

The pea aphis is quite common throughout the state, especially on garden and sweet peas. It has been taken a few times on other plants, such as alfalfa, violets, and leather-root, but it is uncommon. This species is readily distinguished by its bright, shining green color, large size, and long, slender, imbricated, but non-reticulated cornicles.

75. **Macrosiphum pteridis** Wilson

Figures 317, 318

Wilson, Trans. Am. Ent. Soc., vol. 41, p. 101, 1915 (orig. desc.).

Records.—*Pteris aquilina;* Walnut Creek, Contra Costa County, 1915 (Davidson).

This species has been found by Davidson on the fronds of common brake in the San Francisco Bay region. Wilson reported it as present throughout southern and western Oregon. There are a few specimens of the alate females in the author's collection, received from Davidson.

76. **Macrosiphum rosae** (Linn.)

Figures 106, 151, 152

Linnaeus, Syst. Nat. vol. 4, p. 73, 1735. *Aphis* (orig. desc.).
Clarke, Can. Ent., vol. 35, p. 254, 1903. *Nectarophora* (list).
Davidson, Jour. Econ. Ent., vol. 2, p. 304, 1909 (list).
Davidson, Jour. Econ. Ent., vol. 3, p. 380, 1910 (list).
Davidson, Pom. Jour. Ent., vol. 3, p. 399, 1911 (list).
Essig, Pom. Jour. Ent., vol. 5, p. 550, 1911 (desc.).
Carnes, Mon. Bull. Cal. Comm. Hort., vol. 1, p. 398, 1912 (list).

Records.—Rose; through California from Humboldt County south to San Diego County (Clarke, Davidson, Morrison, Essig, Ferris, Shinji, the author).

This is the common pink and green aphid of roses, known the world over. The apterae are found most abundantly in the late winter and early spring on the buds and stems of rose. As the alates are matured they fly away, supposedly either to other rose bushes or to various grains and grasses. This past spring (1917) it has been very abundant in the vicinity of Riverside, but the previous spring (1916) in San Diego it was rare. There the most abundant rose aphis was *Myzaphis rosarum* (Walker).

77. **Macrosiphum rudbeckiae** (Fitch)

Fitch, Cat. Homop. N. Y., p. 66, 1851. *Aphis* (orig. desc.).
Essig, Pom. Jour. Ent., vol. 3, p. 400, 1911. *Aphis* (desc.).[11]
Davidson, Jour. Econ. Ent., vol. 7, p. 137, 1914 (list).

Records.—*Ambrosia psilostachya;* Santa Paula (Essig); *Baccharis viminalis;* Santa Paula (Essig), Riverside, September, 1916; *Dipsacus fullonum;* San Jose (Davidson): *Helianthus annuus;* Riverside, September, 1916; *Salix* sp.; *Chrysanthemum;* Arlington, Riverside County, September, 1916; undetermined species of *Compositae;* Redwood Canyon, Contra Costa County, July, 1914 (R. W. Haegele).

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[11] In the drawings accompanying this description by Essig the following mistakes are noticeable: the third discoidal vein of the forewings is twice-branched instead of once-branched, and the third antenal segment of the apterous female bears several secondary sensoria instead of none, as figured.

This reddish-colored *Macrosiphum* is distributed abundantly through the San Francisco Bay region and southern California on various Compositae. In one case the author found it doing considerable damage to chrysanthemums by stunting and distorting the buds. Once he found it infesting the tender leaves and stalks of willow. The author reared specimens of *Diaretus rapae* Curt. from an infestation of this species taken on willow.

77a. **Macrosiphum rudbeckiae** (Fitch) var. **madia** n.var.

Figures 153, 154

In September, 1915, the author found a species of *Macrosiphum* infesting the heads of tarweed (*Madia sativa*) on the campus of the University of California, Berkeley. Specimens of *Praon simulans* Prao. were reared from this collection. Mounted specimens are almost identical with *M. rudbeckiae* (Fitch), but in life they differ in the coloration. Because of this it has been thought best to describe it herewith as a color variety of *M. rudbeckiae*, naming the variety. *madia*, after its host plant.

Host: *Madia sativa.*	Date: September 12, 1915.
Locality: Berkeley, California.	Collection number: AFS 70-15.

Alate viviparous female.—Prevailing color: dark-green, slightly pruinose. Head brownish (fuscous), about as long as broad, with distinct antennal tubercles. Antennae black, except I and II and the base of III, which are concolorous with the head. The spur is slightly longer than III; IV is next in length, followed by V, VI, and I, which are subequal, and II, which is the shortest segment. The spur is about six times as long as the base of VI. The usual primary sensoria are present on V and VI, and the usual accessory sensoria on VI. IV is without sensoria, III has 25–35 irregularly arranged, various-sized secondary sensoria placed along the whole length of the segment (fig. 154). The thorax is fuscous; the prothorax with rather distinct lateral tubercles. The beak is slightly dusky with the apical one-third black, reaching to the second coxae. The abdomen is greenish with a slight pulverulence, making it appear pruinose. The cornicles are long, slightly tapering, black except the basal one-third, which is concolorous with the abdomen, apical one-fifth reticulate (fig. 153). The cauda is long and pointed, pale (slightly reddish?), about one-half as long as the cornicles. The legs are black except the basal half of the femora and the coxae, which are greenish. The wings and venation are normal.

Measurements: Body length (exclusive of cauda), 2.11 mm.; width of thorax, 0.91 mm. Antennae: total, 2.07 mm.; I, 0.12 mm.; II, 0.09 mm.; III, 0.76 mm.; IV, 0.55 mm.; V, 0.47 mm.; VI, 0.12 mm.; spur, 0.78 mm.; cornicles, 0.91 mm.; cauda, 0.45 mm.; beak, 0.89 mm.; hind tarsus, 0.14 mm. Wing: length, 3.6 mm.; width, 1.25 mm.; expansion, 8.11 mm.

78. **Macrosiphum sanborni** Gillette

Figures 141, 155

Sanborn, Kans. Univ., Sci. Bull. 3, p. 73, 1904. *Macrosiphum chrysanthemi* (desc. ala. vivi.).

Gillette, Can. Ent., vol. 11, p. 65, 1908 (orig. desc. apt. vivi.).

Records.—Chrysanthemum; Stanford University, May, 1915; Riverside, March, 1917.

Twice has the author found this species: once a small infestation in the greenhouse of Stanford University, and once abundantly out of doors in Riverside. It is an interesting species in that it does not fit well into any known genus. Except for the cornicles it fits *Macrosiphum* and has been so considered. The cornicles are, however, short, being scarcely longer than the cauda, and are somewhat bottle-shaped, being considerably smaller at the apex than at the base.

79. **Macrosiphum solanifolii** (Ashmead)

Figures 137–140, 159–160

Ashmead, Can. Ent., vol. 12, p. 91, 1881. *Siphonophora* (orig. desc.).

Clarke, Can. Ent., vol. 35, p. 252, 1903. *Nectarophora citrifolii* (Ashmead) (list).

Davidson, Jour. Econ. Ent., vol. 31, p. 380, 1910. *Macrosiphum citrifolii* (Ashmead) (list).

Essig, Pom. Jour. Ent., vol. 3, p. 592, 1911. *Macrosiphum citrifolii* (Ashmead) (desc.).

Davidson, Jour. Econ. Ent., vol. 5, p. 411, 1912 (list).

Patch, Maine Agr. Exp. Sta., Bull. 242, 1915 (desc.).

Records.—*Citrus* sp.; Azusa, Los Angeles County (Clarke); Lindsey, Tulare County (Clarke); Santa Paula (Essig); *Disporum hookeri;* Berkeley, May, 1915 (Shinji): *Solanum nigrum;* Stanford University, October, 1916 (Ferris): *Fuchsia* sp.; Berkeley, July, 1915: *Sonchus asper* and *S. oleraceus;* Stanford University, February, 1915: apple; Stanford University, May, 1915; El Cajon, San Diego County, July, 1916: *Atriplex* sp.; Berkeley, September, 1915: *Oxalis corniculata,* Riverside, February, 1917: *Deinandra fasciculata,* Riverside, February, 1917: *Erodium moschatum;* Pasadena, April, 1917 (R. E. Campbell); Riverside, April, 1917.

This "pink and green aphid of potato" is distributed throughout California on a large variety of plants. It is recognizable by the long reticulated cornicles and black antennae. When the author first examined specimens of *Macrosiphum citrifolii* (Ashmead) in Essig's collection he was struck with its resemblance to this species. In fact, after considerable study he could not find any constant differences. This was in 1915 in Berkeley. This past spring (1917) he had the opportunity in Riverside of making some transfer tests with specimens from oxalis. Migrants were placed under muslin bags on sucker growth of orange. It was observed that these settled there readily and produced young, demonstrating that the citrus species is the same as the other. On the strength of this *Macrosiphum citrifolii* (Ashmead) is listed as a synonym of this species.

80. **Macrosiphum sonchella** (Monell) ?

Monell, U. S. Geol. Geog. Surv., Bull. 5, p. 21, 1879. *Siphonophora* (orig. desc.).
Clarke, Can. Ent., vol. 35, p. 252, 1903. *Nectarophora* (list).
Davidson, Jour. Econ. Ent., vol. 2, p. 304, 1909 (list).
Davidson, Jour. Econ. Ent., vol. 2, p. 380, 1910 (list).

Records.—Sonchus sp.; Berkeley, Newcastle, and Palo Alto (Clarke); Stanford University (Davidson).

According to Morrison the species listed as this by Davidson is not *Macrosiphum sonchella* (Monell), although he cannot say what it is. Consequently Clarke probably referred to the same species as did Davidson. As the author has never seen specimens he can make no statement as to its identity, so lists it as it has been heretofore.

81. **Macrosiphum stanleyi** Wilson

Figures 128, 158

Wilson, Proc. Ent. Soc. Brit. Columbia, January, 1915 (orig. desc.).

Record.—Sambucus callicarpa californica; Berkeley, June, 1915.

From the early part of June, 1915, until the middle of August, this species was very abundant on an elderberry tree in the Botanical Gardens of the University of California. By the latter part of August all specimens had disappeared. Since then the author has never seen the species. J. J. Davis kindly identified these specimens.

82. **Macrosiphum taraxici** (Kalt.)

Kaltenbach, Monog. d. Pflanzenläuse, p. 30, 1743. *Aphis* (orig. desc.).
Theobald, Jour. Econ. Biol., vol. 7, p. 77, 1913 (desc.).

Record.—*Taraxacum officinale;* California (Wilson).

H. F. Wilson stated to the author that he had taken this species on dandelion (*Taraxacum officinale*) in California, although he gave no date or locality record.

83. **Macrosiphum tulipae** (Monell)

Monell, U. S. Geol. Geog. Surv., Bull. 5, p. 19, 1879. *Siphonophora* (orig. desc.).
Davidson, Jour. Econ. Ent., vol. 3, p. 380, 1910 (list).

Records.—*Tulipa* sp.; Stanford University (Davidson); *Liriodendron* sp.; Berkeley, 1915 (Essig, Shinji).

This species is not known to the author. It has been found on tulips and on the tulip trees in the San Francisco Bay region by Davidson, Essig, and Shinji.

84. **Macrosiphum valerianae** (Clarke)

Clarke, Can. Ent., vol. 35, p. 253, 1903. *Nectarophora* (orig. desc.).

Record.—*Valeriana officinialis;* Berkeley (Clarke).

In 1903 Clarke described this species from specimens taken on heliotrope in Berkeley. Since then it has not again been found.

24. Genus **Myzus** Passerini

Passerini, Gli Afidi, 1860. Type *Aphis ribes* Linnaeus.

This genus is very closely related to *Rhopalosiphum* Koch, the principal difference being in the shape of the cornicles. However, some species fall easily into one or the other genus, depending entirely upon what form one has. In this respect *Rhopalosiphum persicae* (Sulz.) is particularly noticeable, the spring migrants having the clavate cornicles of *Rhopalosiphum,* the fall migrants having the cylindrical cornicles of *Myzus.* The author has followed Van der Goot in taking out of this genus *M. rosarum* (Walker) and placing it in the genus *Myzaphis* v.d.G. The antennal tubercles are lacking, thus placing the species in the Aphidini instead of the Macrosiphini. There are at present ten species of *Myzus* known to occur in California. Following is a key to them:

Key to the California Species

Alate viviparous females

1. Secondary sensoria present on III only 5
— Secondary sensoria present on other segments as well as on III 2
2. Secondary sensoria on III, IV, and V 3
— Secondary sensoria on III and IV, none on V .... **fragaefolii** Cockerell
3. Cornicles dusky for entire length .... **cynosbati** (Oestlund)
— Cornicles mostly pale 4
4. Thoracic lobes distinctly darker than general body color, being black or dark brown .... **aquilegia** Essig
— Thoracic lobes at most only slightly darker than body, being a pale brown. **braggii** Gillette
5. Body black throughout .... **cerasi** (Fabricius)
— Body not black throughout 6
6. Cornicles pale except at extreme tip 7
— Cornicles with more than tip dusky 8
7. VI spur longer than III, the latter with but 9 to 12 sensoria. **varians** Davidson
— VI spur at most equal to III, the latter with 18 to 26 sensoria. **lycopersici** (Clarke)
8. Cornicles longer than either IV or V 10
— Cornicles not longer than either IV or V 9
9. VI spur longer than II .... **circumflexum** (Buckton)
— VI spur shorter than III .... **ribifolii** Davidson
10. III with 15 to 25 sensoria (fig. 178) .... **rhamni** (Fonsc.)
— III with but 9 to 12 sensoria .... **varians** Davidson

Apterous viviparous female

1. Body covered with capitate hairs 2
— Body not covered with capitate hairs except on head and antennae 5
2. Secondary sensoria on III 3
— No secondary sensoria on III 4
3. Cornicles dusky .... **ribifolii** Davidson
— Cornicles pale except tip .... **aquilegiae** Essig
4. Cornicles almost twice as long as III. Body fairly large sized. **braggii** Gillette
— Cornicles but slightly longer than III. Body small sized. **fragaefolii** Cockerell
5. Secondary sensoria on III 6
— No secondary sensoria on III 7
6. VI spur longer than III. Several sensoria scattered along the whole length of III .... **cynosbati** (Oestlund)
— VI spur at most equal to III. Only a few (1–3) sensoria at base of III. **lycopersici** (Clarke)
7. III longer than cornicles. Dorsum of abdomen with dusky markings, shaped somewhat as a horseshoe .... **circumflexum** (Buckton)
— III at most equal to cornicles. Abdomen not marked as above 8
8. Body black throughout .... **cerasi** (Fabricius)
— Body not black throughout 9
9. VI spur almost twice as long as III .... **varians** Davidson
— VI spur but slightly longer than III .... **rhamni** (Fonsc.)

85. **Myzus aquilegiae** Essig

Shinji, Can. Ent., vol. 40, p. 49, 1917. *Myzus* sp. (list).
Essig, Univ. Calif. Publ. Entom., vol. 1, p. 314, 1917 (orig. desc.).

Records.—Aquilegia truncata; Berkeley, 1916 (Essig): *A. vulgare,* Inverness, Marin County (Shinji).

This species was recently described by Essig from specimens found on columbine on the campus of the University of California, Berkeley. The author has had access to cotype specimens, although he has never collected it himself.

86. **Myzus braggii** Gillette

Figure 176

Gillette, Can. Ent., vol. 11, p. 17, 1908 (orig. desc.).
Davidson, Jour. Econ. Ent., vol. 5, p. 409, 1912. *Phorodon carduinum* (Walker) (list).

Records.—Cynara scolymus; Courtland, Oakland, and San Jose (Davidson); Riverside, January and February, 1917.

The author found this species during the early spring of 1917 infesting the leaves of artichoke in Riverside. The determination of specimens was verified by C. P. Gillette. Davidson reported *Phorodon carduinum* (Walker) from artichoke in the San Francisco Bay region. His specimens were determined by J. Monell, but P. Van der Goot was doubtful as to its identity. Davidson himself has decided that the species is *Myzus braggii* Gillette. There is no doubt but that the species on artichoke in California is *M. braggii* Gillette, but whether or not this is the same as *P. carduinum* (Walker) is uncertain.

87. **Myzus cerasi** (Fabricius)

Figures 112, 121, 122, 179, 307

Fabricius, Syst. Nat., p. 734. *Aphis* (orig. desc.).
Clarke, Can. Ent., vol. 35, p. 252, 1903 (list).
Gillette, Jour. Econ. Ent., vol. 1, p. 362, 1908 (desc.).
Newman, Mon. Bull. Calif. Comm. Hort., vol. 4, p. 446, 1915 (list).
Shinji, Can. Ent., vol. 49, p. 49, 1917 (list).

Records.—Prunus cerasi; Susanville, Lassen County (Newman); Berkeley, 1914, 1915, and 1916 (Essig, Shinji); Riverside, 1914 (Sharp); Fresno, June, 1915: *Prunus domestica;* Berkeley (Clarke).

The black cherry aphis is found occasionally throughout California, but seldom in large enough numbers to be injurious. It infests the terminal leaves of cherry, and sometimes other species of *Prunus*, causing them to curl to a certain extent. Eggs are laid in the late fall and early winter in the crevices of the bark and near the bases of the buds. These hatch the following spring about the time the buds are opening. The first few generations consist entirely of apterous females. In the early summer the alate females appear, and continue to do so in each succeding generation until fall. In fact, after the first of July, or thereabouts, the majority of the lice produced are alate until the sexes appear in the fall. The first alate females taken by the author were on June 7, 1915. However, on April 25, 1916, Essig found a few alate females in Berkeley. In August, 1914, the apterae were also found in Berkeley.

Van der Goot makes this species out of the genus *Myzus*, using it as the type of his genus *Myzoides*. The author is inclined to follow him inasmuch as this is quite different from other members of this genus, approaching *Aphis* in its robust form and separated from that only by the length of the cornicles and presence of antennal tubercles. However, it has so long been considered as a species of *Myzus* that it is best to leave it so. It is not a good policy usually to form a new genus for one species, especially when it has for so long been considered as a member of another genus.

88. **Myzus circumflexus** (Buckton)

Figure 175

Buckton, Monog. Brit. Aphides, vol. 1, p. 130, 1875. *Siphonophora* (orig. desc.).
Gillette, Can. Ent., vol. 40, p. 19, 1908. *M. vincae*, n.sp. (desc.).
Davidson, Jour. Econ. Ent., vol. 3, p. 380, 1910. *M. vincae* Gill. (list).
Shinji, Can. Ent., vol. 49, p. 49, 1917 (list).

Record.—Vinca major; Stanford University (Davidson, Morrison), Berkeley, 1915 (Shinji), Los Angeles, March, 1917; *Aesculus californicus, Alopecurus pratensis, Asparagus,* spp., *Ceanothus* sp., *Cerastium viscosum, Cheiranthus chieri, Cyrtonium falcatum, Digitalis purpurea, Fuchsia* sp., *Gladiolus* sp., *Plantago* sp., *Senecio mikanioides, Sisymbrium* sp., *Solanum* spp., *Stachys bullata, Tropaeolum* sp., *Symphoricarpus racemosus;* Berkeley, 1915, 1916 (Essig, Shinji): *Viola tricolor;* Stanford University, March, 1915; Berkeley, 1915 (Essig, Shinji): *Richardia africana;* Pomona, 1909 (Essig); Stanford University, March, 1915; Berkeley, March, 1915 (Essig); San Diego, May, 1916; Los Angeles, March, 1917.

This very common aphid is found in the spring on a large variety of host plants throughout California. At times it may become so abundant as to cause some considerable damage to its host. On March 4, 1917, the author observed it on periwinkle in Los Angeles in such numbers as to stunt the flowers and to cause all the plants to appear black and sticky. The apterae of this species are readily recognized by the black horseshoe-shaped marking on the dorsum of the abdomen.

89. **Myzus cynosbati** (Oestlund)

Oestlund, Minn. Geol. and Nat. Hist. Surv., Bull. 4, p. 81, 1887. *Nectarophora* (orig. desc.).
Davidson, Jour. Econ. Ent., vol. 10, p. 294, 1917 (note).
Shinji, Can. Ent., vol. 49, p. 49, 1917. *M. ribis* (Linn.) (list).

Records.—Ribes vulgare; Walnut Creek (Davidson); *Ribes glutinosum, R. menziesii;* Berkeley, April, 1915 (Shinji).

This species has been taken but a few times in the San Francisco Bay region; once on cultivated red currant in company with *Aphis neomexicana pacifica,* once on wild flowering currant, and once on wild canyon gooseberry. Furthermore, only the sexapura (migrants) and sexuales have been taken. Davidson writes that this is true *cynosbati* of Oestlund and not the species described by Davis (Ann. Ent. Soc. Am., vol. 2, p. 38, 1909), as *Macrosiphum cynosbati* (Oest.), which is not that species but some other. Shinji listed *M. ribis* (Linn.), but his specimens prove to be the sexuales of this species.

90. **Myzus fragaefolii** Cockerell

Figure 177

Cockerell, Can. Ent., vol. 33, p. 101, 1901 (orig. desc.).
Davidson, Jour. Econ. Ent., vol. 7, p. 135, 1914 (desc. sexuales).

Records.—Fragaria chiloensis; Walnut Creek, Contra Costa County (Davidson); Berkeley, March to September, 1915; Palo Alto, April, 1915; Ontario, April, 1917; Buena Park, Orange County, May, 1917 (R. K. Bishop); Santa Barbara, May, 1917; Rialto, San Bernardino County, May, 1917 (A. B. Snow): *F. californicus:* Pine Hills, San Diego County, June, 1916.

On the under side of the leaves of native and cultivated strawberries this small yellowish aphid is often found, both in the San Francisco Bay region and in southern California. Seldom does it become abundant, although several records of its abundance were received from various parts of the south during the spring of 1917. Several growers have thought it bad enough to spray for it. During the late winter (January and February) the sexuales appear and the eggs are laid. These hatch in a short time, and during the rest of the year the alate and apterous viviparae are found.

91. **Myzus lycopersici** (Clarke)

Clarke, Can. Ent., vol. 35, p. 253, 1903. *Nectarophora* (orig. desc.).
Davis, Can. Ent., vol. 46, p. 123, 1914 (desc.).

Record.—Lycopersicum esculentum; Berkeley (Clarke).

Only once has this species been found in California. Davis in 1914 described a species from tomato in Idaho, Montana, and Oregon which he believed to be this one. It may be, and it may not be so. That can never be decided for the types of Clarke's species are all lost.

92. **Myzus rhamni** (Clarke)

Figure 178

Clarke, Can Ent., vol. 35, p. 254, 1903. *Nectarophora* (orig. desc.).
Shinji, Can. Ent., vol. 49, p. 49, 1917. *M. rhamni* (Boyer) (list).

Records.—Rhamnus californicus; Berkeley (Clarke), Berkeley, March, 1915 (Shinji).

In March, 1915, George Shinji took a species of *Myzus* from coffeeberry in Berkeley. This fits Clarke's description of *Nectarophora rhamni,* in so far as the description goes. The author considers it to be the same species as described by Clarke, inasmuch as it was collected in the same locality and on the same host plant.

Wilson (Can. Ent., vol. 44, p. 156, 1912) describes a species from *Rhamnus purshiana* in Oregon as *M. rhamni* (Boyer), listing Clarke's species as a synonym. This is the same species as taken by Shinji in Berkeley, but it is doubtful if it is the species described by Boyer de Fonscolombe. Specimens in the author's collection from *Rhamnus* in Colorado are determined by Gillette and Bragg to be *Aphis rhamni* Fonsc. These are certainly different from the coast species, the former being an *Aphis* closely related to *A. euonomii* Fabr., the latter a *Myzus.* From this evidence the author cannot follow Wilson in placing *Nectarophora rhamni* Clarke as a synonym of *Aphis rhamni* Fonsc., considering both as *Myzus,* but he considers them as distinct, Clarke's species being a *Myzus,* Fonscolombe's an *Aphis.*

93. **Myzus ribifolii** Davidson

Davidson, Jour. Econ. Ent., vol. 10, p. 294, 1917 (orig. desc.).

Record.—Ribes glutinosum; Redwood Canyon, Contra Costa County (Davidson).

Davidson recently described all forms of this species from specimens taken during March, April, and May, 1913, 1914, and 1915, on wild flowering currant in Redwood Canyon, Contra Costa County. The author is unacquainted with the species.

94. **Myzus varians** Davidson

Davidson, Jour. Econ. Ent., vol. 5, p. 409, 1912 (orig. desc.).

Record.—Clematis ligusticifolia; San Jose (Davidson).

Davidson found this species on the under side of the leaves of wild clematis, or *Yerbade chivato,* near San Jose, and later in Walnut Creek, Contra Costa County. The author is unacquainted with the species.

25. Genus **Nectarosiphon** Schouteden

Schouteden, Aphidologische Notizen, Leipzig, 1901. Type *Macrosiphum rubicola* Oestlund, n.n. for *Macrosiphum* Oestlund, preoccupied.

KEY TO CALIFORNIA SPECIES

1. Body quite large, being about 3 to 4 mm. in length. Wings with dusky spot near tip .... **rubicola** (Oestlund)

— Body not so large, being only about 1.5 mm. long. Wings without dusky spot near tip .... **morrisoni** Swain

95. **Nectarosiphon rubicola** (Oestlund)

Figures 107, 109, 123

Oestlund, Minn. Geol. Nat. Hist. Surv., vol. 14, p. 27, 1886. *Macrosiphum* (orig. desc.).

Davidson, Jour. Econ. Ent., vol. 7, p. 136, 1914. *Amphorophora* (list).

Records.—Rubus nutkanus; Contra Costa County (Davidson); Berkeley (Essig, Shinji).

This species is sometimes found infesting the tender leaves and shoots of thimbleberry in the San Francisco Bay region. The most distinctive character which readily separates it from *Amphorophora rubi* (Kalt.) is the presence of a dusky patch near the tip of the forewing. This was originally described by Oestlund as the type of his genus *Macrosiphum.* However, this name was preoccupied by *Macrosiphum* Passerini, so Schouteden proposed the name *Nectarosiphon* for this genus. Davidson listed this species as *Amphorophora,* and Morrison writes that he has never been able to satisfy himself why this is not *Amphorophora* instead of *Nectarosiphon*. There is considerable difference in the antennal tubercles of this species and species of *Amphorophora*, although otherwise they are quite similar. The author believes that slight as the difference is it should be recognized for it is through the shape and size of the antennal tubercles that the different genera of the Macrosiphini are recognized in a large part. In this species the tubercles are large and distinct and neither gibbous nor toothed on the inner side, and with the outer side quite evident, while in *Amphorophora* they are small and distinctly toothed on the inner side, with the outer side a mere line, or not at all evident.

96. **Nectarosiphon morrisoni** Swain

Figures 124 to 127

Swain, Trans. Am. Ent. Soc., vol. 44, p. 8, 1918.

Records.—*Cupressus macrocarpa;* San Francisco (Compere, Morrison), San Diego (Swain): *C. guadalupensis;* San Diego (Swain).

In Golden Gate Park, San Francisco, and in Exposition Park, San Diego, this species has been taken on cypress. The small, slender, long-legged apterae are found infesting the terminal leaves of the host. Occasionally an alate female is seen. In San Diego, the apterae were found in company with *Cerosipha cupressi* Swain.

26. Genus **Pentalonia** Coquerel

Coquerel, Ann. Ent. Soc. France, vol. 7, p. 239, 1860. Type *P. nigronervosa* n.sp.

97. **Pentalonia nigronervosa** Coquerel

Coquerel, Ann. Ent. Soc. France, vol. 7, p. 239, 1860 (orig. desc.).
Wilson, Jour. Econ. Ent., vol. 2, p. 346, 1909 (desc.).

Record.—*Pelargonium* sp.; Stanford University (Morrison).

The following note concerning this species is from Morrison:

Pentalonia nigronervosa Coquerel. See Wilson, Jour. Econ. Ent., 1909. In the Davidson collection (belonging to Stanford University) there is a single glycerine jelly mount of this species. I have been able to see enough of it to be certain of its identity with that described by Wilson in the *Journal* (above). The record is from geranium, and Davidson once told me that he found it in alcohol in the laboratory [of Stanford University] at the time he began his study of the *Aphididae*. I believe the record should be published.

27. Genus **Phorodon** Passerini

Passerini, Gli Afidi, 1860. Type *P. humuli* Schr.

No attempt has been made to formulate a key to the California species of this genus, owing to the fact that the author has specimens of but one species, and that the description of the other is quite inadequate. Four species have been reported from this state, two of which prove to be species of other genera and one of which is very doubtful. *Phorodon carduinum* (Walker) as reported by Davidson, is *Myzus braggi* Gillette. *Phorodon galeopsidis* (Kaltenbach), also reported by Davidson, is *Rhopalosiphum hippophoaes* Koch. There is much diversity of opinion concerning the specific determination of these species and of *Myzus elaeagni* Del Guercio. One might refer to Gillette's paper on *Rhopalosiphum hippophoaes* Koch and *Myzus braggii* Gillette. Davis writes that he is not prepared to be quoted. Davidson lists *P. galeopsidis* and *R. hippophoaes* as synonyms. He states that his specimens listed as *P. carduinum* Walker were determined by Monell, but that Van der Goot is doubtful, while he himself believes them to be *M. braggii* Gillette. He has been followed in so listing them. This then leaves but two species reported from California.

98 **Phorodon humuli** (Schrank)

Figures 115 to 118

Schrank, Fauna Boica, vol. 2, p. 110, 1801-02. *Aphis* (orig. desc.).
Clarke, Can. Ent., vol. 35, p. 252, 1903 (list).
Clarke, Calif. Agri. Exp. Sta., Bull. 160, 1904 (econ.).
Parker, U. S. Dept. Agri., Bull. 111, 1913 (econ.).
Vosler, Mon. Bull., Cal. Comm. Hort., vol. 2, p. 668, 1913 (list).

Records.—*Humulus* spp.; Berkeley (Clarke); Placer County (Vosler); Berkeley, July to September, 1915: *Prunus domestica;* Berkeley, March to April, 1915 (Essig, Shinji); (Parker).

This is the common hop plant louse found throughout the central part of the state. During the summer it is common on hops, but in the fall the sexupara migrate to plum, where the eggs are laid. These eggs hatch the following spring into stem mothers which feed on the opening buds of plum. During later generations, probably about the third or fourth, alate fundatrigeniae appear, which leave the plum and migrate to hop. Here the summer generations are produced until well into the fall. Parker states that the normal life cycle is as just stated, but that it is also possible, and it occasionally occurs, that this aphid may live the entire year upon hops, or on plum, generation after generation of parthenogenetic females being produced.

99. **Phorodon scrophulariae** Thomas

Thomas, Ann. Rep. Ill. St. Ent., vol. 8, p. 72, 1879 (orig. desc.).
Clarke, Can. Ent., vol. 35, p. 252, 1903 (list).

Record.—Scrophularia sp., Berkeley (Clarke).

This is a doubtful species, reported by Clarke as present on *Scrophularia* in Berkeley, and by Dr. Thomas in 1879 on a species of plant which he thought to be *Scrophularia* in Illinois. Since Clarke's record it has never been found, although Morrison states that he has spent considerable time examining the common *Scrophularia* plants in the vicinity of Stanford University, but to no avail. The author attempted to find it many times in the vicinity of San Diego during 1916, and in the vicinity of Riverside in 1917, with no success.

28. Genus **Rhopalosiphum** Koch

Koch, Die Pflanzenläuse, p. 23, 1854. Type *Aphis persicae* Sulz.

This genus is very closely related to *Myzus*, and is distinguished only by the shape of the cornicles. This distinction is variable, however, as in some species certain forms have the clavate cornicles of *Rhopalosiphum* while other forms have the cylindrical cornicles of *Myzus*. This is particularly true in the case of *Rhopalosiphum persicae* (Sulz.) and *Myzus braggii* Gillette. However, most aphidologists separate these two genera, so the author feels that it is best to do so.

KEY TO CALIFORNIA SPECIES

Alate viviparous females

1. Ground color dark (olive-green, wine, brown, and so forth) 2
— Ground color light, usually green (this does not refer to the dark markings on head, thorax, or abdomen, but rather to the ground color of the abdomen) 4
2. Wing veins with smoky borders and tips (fig. 164). IV with a few small sensoria .... **violae** Pergande
— Wing veins without smoky borders or tips, and IV without sensoria. **rhois** Monell
3. Antennae distinctly tuberculate, with sensoria on both III and IV (figs. 170, 279) 4
— Antennae not tuberculate, and IV without sensoria, or at most with but a few small ones (figs. 167, 168) 5

4. VI spur slightly longer than III (figs. 279, 281). Cornicles quite large and heavy (figs. 282, 284) .... **lactucae** (Kalt.)
— VI spur about twice as long as III. Cornicles comparatively small and slender (fig. 165) .... **hippophoaes** Koch.
5. First discoidal vein with distinct, smoky border, second discoidal bordered slightly so (fig. 166) .... **nervatum** Gillette
— First and second discoidal without smoky borders 6
6. Abdomen with dusky dorsal markings. III with a few (10–12) sensoria (fig. 168) .... **persicae** Sulz.
— Abdomen without dusky dorsal markings. III with many (24–30) sensoria (fig. 167) .... **corylinum** Davidson

Apterous viviparous females[12]

1. Ground color dark (olive-green, wine, brown) 2
— Ground color light (green, and so forth) 3
2. Cornicles large and stout, longer than III .... **rhois** Monell
— Cornicles smaller and more slender, shorter than III .... **violae** Pergande
3. Cornicles longer than III 4
— Cornicles shorter than III 5
4. VI spur considerably longer than III, and subequal to cornicles. **nervatum** Gillette
— VI spur about equal to III, and distinctly shorter than cornicles. **hippophoaes** Koch.
5. III with secondary sensoria .... **lactucae** (Kalt.)
— III with no secondary sensoria .... **persicae** (Sulz.)

100. **Rhopalosiphum corylinum** Davidson

Figure 167

Davidson, Jour. Econ. Ent., vol. 7, p. 134, 1914 (orig. desc.).

Records.—Corylus rostrata; Walnut Creek, Contra Costa County (Davidson): *Physocarpus capitatus;* (Davidson).

This species was originally described from specimens of alate viviparae and pupae taken on wild hazelnut near Walnut Creek. Davidson writes that he has found it quite common on ninebark in the San Francisco Bay region. The author has never taken the species, but has had access to cotype specimens in Essig's collection.

101. **Rhopalosiphum hippophoaes** Koch

Figures 165, 170

Koch, Die Pflanzenläuse, p. 28, 1854 (orig. desc.).

Davidson, Jour. Econ. Ent., vol. 7, p. 136, 1914. *Phorodon galeopsidis* Kalt. (list).

Gillette, Jour. Econ. Ent., vol. 8, p. 375, 1915 (synonomy).

Record.—Polygonum sp.; San Jose (Davidson).

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[12] *R. corylinum* Dvdn. is omitted from this key as the apterous female was never described and specimens are not available to the author.

Davidson reported this species as present on knotweed in the vicinity of San Jose, under the name *P. galeopsidis* Kalt. Later he followed Gillette in placing it as a synonym of *R. hippophoaes* Koch. The author has never collected it, but has had access to specimens from Davidson in San Jose, and Davis in Oak Park, Illinois. For a full discussion of the synonymy of this species see Gillette's paper listed above.

102. **Rhopalosiphum lactucae** (Kalt.)

Figures 277 to 285

Kaltenbach, Monog. d. Pflanzenläuse, p. 37, 1843. *Aphis* (orig. desc.).
Davidson, Jour. Econ. Ent., vol. 3, p. 277, 1910 (list).

Records.—Sonchus spp.; Stanford University (Davidson); Stanford University, May to July, 1915; Walnut Creek, May, 1915 (Davidson); Berkeley, July, 1915; Lemon Grove, San Diego County, January, 1916; Riverside, January to May, 1917; Los Angeles, April, 1917: *Asclepias* sp.; Corvallis, Oregon, November, 1913 (Moznette).

This is a common species infesting the heads of sow thistle throughout the San Francisco Bay region and southern California. In November, 1913, G. F. Moznette took it on milkweed in Corvallis, Oregon. This collection consisted entirely of alate females, that may have been the sexupara. Inasmuch as the identity of this species is doubtful there is given below a brief description drawn from specimens of nine alates and eight apterae taken on *Sonchus* spp. at Stanford University in May, 1915, in Walnut Creek in May, 1915, in Berkeley in July, 1915, and in Lemon Grove in January, 1916, and on *Asclepias* sp. in Corvallis, Oregon, in November, 1913. This latter collection is by George F. Moznette of Corvallis.

Alate viviparous female.—Prevailing color is apple green with the head dark green to black, the prothorax apple green, the thoracic lobes black. The abdomen is apple green with three pair of dusky marginal spots on segments one, two, and three, respectively, and with a larger dusky patch on the dorsum of segments four, five, and six, being between the cornicles. The cornicles and cauda are luteous with the extreme tip of the former dusky. The antennae are dusky throughout. The legs are luteous with the tarsi and tips of the femora and tibiae dusky.

The head is about twice as broad as long, with a distinct frontal tubercle (fig. 278). The antennae are set on distinct tubercles and are between one and one-fourth to one and one-half times as long as the body. The relative lengths of the segments are as follows: the spur is the longest, being followed by III, which is subequal but never longer. IV is about one-half the length of the spur and slightly longer than V. II is slightly longer than VI, which is about equal to I. Sensoria are arranged as follows (figs. 279–281): on V and VI are the usual primary and accessory sensoria; on V in addition to the primary sensoria, there are at times as many as seven small circular secondary sensoria, located about the middle of the segment. The number of these sensoria range from none to seven, two and three being the usual number; on IV there are from six to twelve irregular secondary sensoria (fig. 280), placed irregularly along the whole length of the segment; on III there are between thirty and forty irregularly placed and irregularly sized sensoria (fig. 279) scattered along the whole length of the segment. The usual number is from thirty-six to thirty-nine. The prothorax is without lateral tubercles. The beak is of medium length, reaching to slightly beyond the second coxae. The cornicles (fig. 282) are fairly large and clavate on one side. At the widest point they are slightly less than one-fifth the length. The tip is slightly wider than the base. They are about the same length as the fourth antennal segment, although in some cases they may be slightly longer, and in others slightly shorter, but in all cases longer than the fifth antennal segment. The cauda (fig. 283) is long and fairly large, not quite reaching to the tip of the cornicles, being about one-half as long as the cornicles and one-half as long again as the hind tarsi. The wings and venation are normal, the forewings being about twice as long as the body.

Measurements: Body length, 1.48 to 1.87 mm.; width, 0.73 to 0.82 mm.; antennae total, 2.35 to 2.51 mm.; III, 0.544 to 0.697 mm.; IV, 0.306 to 0.425 mm.; V, 0.218 to 0.357 mm.; VI, 0.085 to 0.119 mm.; spur, 0.68 to 0.799 mm.; cornicles, 0.323 to 0.459 mm.; cauda, 0.187 to 0.255 mm.; hind tarsi, 0.136 to 0.153 mm.; wing length, 3.4 to 3.8 mm.; wing width, 1.2 to 1.5 mm.; wing expansion, 8.0 to 8.3 mm. The average measurements are as follows: body length, 1.74 mm.; width, 0.768 mm.; antennae total, 2.445 mm.; III, 0.645 mm.; IV, 0.382 mm.; V, 0.328 mm.; VI, 0.107 mm.; spur, 0.753 mm.; cornicles, 0.403 mm.; cauda, 0.248 mm.; hind tarsi, 0.139 mm.; wing length, 3.6 mm.; width, 1.32 mm.; expansion, 8.1.

Apterous viviparous female.—Prevailing color pale green with the head paler, being almost luteous or of a pale yellowish green color. The eyes are red. The antennae, except the apices of segments three to six inclusive, the legs, except the tarsi and tips of the tibiae, the cauda, and the cornicles, except the tip, are all luteous. Sensoria are as follows: on V and VI the usual primary sensoria, on VI the accessory sensoria, and on III (fig. 278), from nine to eleven small, circular irregularly placed secondary sensoria. IV is without sensoria. The antennae are considerably longer than the body, the spur and III being subequal and the longest segments. Sometimes the spur is slightly longer than III. V is about one-half as long as III or the spur, and about four-fifths as long as IV. I and VI are subequal, being about one-seventh as long as the spur. The cornicles (fig. 284), are clavate, quite large, usually being slightly more than one-fifth the length of the body and over three times the length of the hind tarsi. The cauda (fig. 285) is long, sickle-shaped, and a little more than one-half as long as the cornicles.

Measurements: Body length, 1.7 to 2.18 mm.; width of abdomen, 0.82 to 1.73 mm.; antennae total, 2.32 to 2.48 mm.; III, 0.646 to 0.714 mm.; IV, 0.391 to 0.425 mm.; V, 0.323 to 0.34 mm.; VI, 0.102 mm.; spur, 0.646 to 0.782 mm.; cornicles, 0.459 to 0.493 mm.; cauda, 0.238 to 0.272 mm.; hind tarsi, 0.136 to 0.153 mm. The average measurements are as follows: body length, 1.87 mm.; width, 0.99 mm.; antennae total, 2.39 mm.; III, 0.674 mm.; IV, 0.408 mm.; V, 0.334 mm.; VI, 0.102 mm.; spur, 0.7099 mm.; cornicles, 0.473 mm.; cauda, 0.255 mm.; hind tarsi, 0.1445 mm.

103. **Rhopalosiphum nervatum** Gillette

Figures 166, 169, 171

Gillette, Can. Ent., vol. 40, p. 63, 1908 (orig. desc.).
Davidson, Jour. Econ. Ent., vol. 3, p. 378, 1910. *R. arbuti*, n.sp. (desc.).
Davidson, Jour. Econ. Ent., vol. 7, p. 134, 1914 (list).

Records.—Arbutus menziesii; Stanford University, San Jose, Walnut Creek (Davidson); Sacramento (Essig); Stanford University, February to May, 1915; Berkeley, September, 1915: *Arbutus unedo;* Redlands, February, 1917; *Rosa* spp.; Walnut Creek (Davidson); Berkeley, February, 1915 (Essig).

In 1910 Davidson described a species of *Rhopalosiphum,* which he named *arbuti,* from specimens taken on madrone in the vicinity of Stanford University. Since then it has been found quite commonly on madrone throughout the San Francisco Bay region, and once on a strawberry tree in Silva Park, Redlands. It was noticed by the author that the alate females were very scarce at all times, although the apterae and nymphs were often quite abundant. Later, when studying specimens while working up a key to the species of *Rhopalosiphum,* he found that structurally this species was identical with *Rhopalosiphum nervatum* Gillette. The latter had been taken on roses in the San Francisco Bay region. The identical structure and the scarcity of alates on madrone led to a belief that they were the same species. However, it was too late in the season (October, 1915) to try any transfer tests. No opportunity was found to try migration tests until in February, 1917, when the species was taken in Redlands. Two alate females were reared in the laboratory and then placed under a muslin bag on a rose bush, out of doors. A few days later these were examined and several young larvae observed. No further observations were made for two weeks, when it was found that the bag had been ripped off by the severe winds. Although this test was not a complete success the author feels confident of the identity of this species.

104. **Rhopalosiphum persicae**[13] (Sulz.)

Figures 108, 119, 120, 168

Sulzer, Kan. Ins., p. 105, 1761. *Aphis* (orig. desc.).
Clarke, Can. Ent., vol. 35, p. 252, 1903. *Rhopalosiphum dianthi* (Schrank) (list).
Gillette, Jour. Econ. Ent., vol. 1, p. 359, 1908. *Myzus* (desc.).
Davidson, Jour. Econ. Ent., vol. 2, p. 303, 1909. *R. dianthi* (Schrank), *R. achyrantes* Monell, and *Myzus* (list).
Davidson, Jour. Econ. Ent., vol. 3, p. 377, 1910. *R. tulipae* Thomas (list).
Davidson, Jour. Econ. Ent., vol. 3, p. 378, 1910. *R. dianthi* (Schr.) (list).
Davidson, Jour Econ. Ent., vol. 3, p. 379, 1910. *Myzus* (list).
Essig, Pom. Jour. Ent., vol. 3, p. 598, 1911. *Myzus* (desc.).

Records.—Throughout California by Clarke, Davidson, Essig, Ferris, Morrison, and the author on *Abutilon* sp., *Amaranthus retroflexus, Amsinckia respectabilis, Bougainvillaea* sp., *Brassica* spp., *Capsella bursa pastoris, Capsicum annuum, Catalpa* sp., *Chenopodium murale, Citrus* spp., *Cynoglossum grande, Cytisus proliferus, Geranium carolinianum, Hedera helix, Lycopersicum esculentum, Malva parviflorus, Oxalis oregona, Prunus* spp., *Ranunculus californicus, Raphanus sativus, Rumex* spp., *Sambucus glauca, Sanicula menziesii, Senecio vulgare, Solanum tuberosum, Sonchus* spp., *Tropaeolum* sp., *Tulipa* sp., *Vinca major.*

This green peach aphis is one of the most common aphids found in the state. It is most abundant in the spring, at which time it will be found on almost any plant. According to Gillette various species of *Prunus* are the winter hosts in Colorado, while during the summer it migrates to other plants. In California, however, winter eggs are not laid, the viviparous females living the year round. So far as the author has observed in over three years, only the form with clavate cornicles is found in California.

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[13] George Shinji (Can. Ent., vol. 49, p. 49, 1917) recently described an aphid from specimens taken on *Godetia amaena* in Berkeley, which he named *Myzus godetiae* n.sp. The author has not seen specimens of this species, but from the description and figures, it is in all probability *Rhopalosiphum persicae* (Sulz.).

105. **Rhopalosiphum rhois** Monell

Figure 173

Monell, U. S. Geol. Geog. Surv., Bull. 5, p. 27, 1879 (orig. desc.).
Davis, Can. Ent., vol. 46, p. 165, 1914. *R. howardi* (Wils.) (desc.).
Essig, Univ. Calif. Publ. Ent., vol. 1, p. 330, 1917. *R. howardi* (Wils.) (list).
Ibid., p. 334, 1917 (list).

Records.—*Rhus diversiloba;* Berkeley, April, 1915; *Avena sativa,* Berkeley, (Essig).

This species has been taken in Berkeley on poison oak and grasses. Essig reported it recently as *R. howardi* (Wils.), but according to Gillette[14] this is a synonym of *R. rhois* Monell, *Rhus* being the winter host, and various species of *Graminaceae* the summer hosts.

This species does not seem to be a typical *Rhopalosiphum*, being quite close to *Siphocoryne nymphaeae* Linn., but yet not fitting the generic description of *Siphocoryne* exactly. Consequently it is best to list it as has been done heretofore as *Rhopalosiphum*.

106. **Rhopalosiphum violae** Pergande

Figures 164, 174

Pergande, Can. Ent., vol. 32, p. 29, 1900 (orig. desc.).
Essig, Pom. Jour. Ent., vol. 1, p. 4, 1909 (desc.).
Davidson, Jour. Econ. Ent., vol. 2, p. 303, 1909 (list).
Davidson, Jour. Econ. Ent., vol. 3, p. 277, 1910 (list).

Records.—*Viola* spp.; Claremont, Santa Paula (Essig); Stanford University (Davidson); Palo Alto, May, 1915; Santa Ana, February, 1917; Riverside, April, 1917.

This beautiful little aphid is found more or less abundantly in the spring on the under side of the leaves of violets throughout the state. The dark red color and broad black wing veins serve to distinguish it readily from other aphids.

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[14] Gillette, Jour. Econ. Ent., vol. 8, p. 100, 1915.

Tribe **Aphidini** Wilson

Wilson, Ann. Ent. Soc. Am., vol., 3, p. 331, 1910.

Following is a brief characterization of this tribe, from Wilson:

> The characters which separate this tribe from the previous one [Macrosiphini] are taken as follows: Antennae shorter than the body, or when as long as the body the cornicles and cauda are very short; antennal tubercles, when present, are indistinct, or else the cornicles and cauda are small; when the cornicles are very long or large the development is limited and the other characters are used to place the genera.

The California genera included by Wilson in this tribe are *Aphis, Cerosipha, Coloradoa, Hyalopterus, Liosomaphis,* and *Siphocoryne* [*Hyadaphis*]. In addition to these the author includes *Toxoptera* because of the small and indistinct antennal tubercles and the short cornicles, and *Myzaphis* because of the absence of antennal tubercles. The key to the California genera has been formulated by the author, following Wilson, Mordwilko, and Van der Goot.

1. Antennae five-segmented .... **Cerosipha** del Guercio

— Antennae six-segmented 2

2. Cornicles much shorter than cauda .... **Hyalopterus** Koch

— Cornicles about as long as or longer than cauda 3

3. Cornicles cylindrical, tapering, or conical, not distinctly clavate (fig. 182), except in *Coloradoa* and *Myzaphis*, in which they may be slightly clavate at the apex (fig. 315) 5

— Cornicles distinctly clavate (figs. 183, 184) 4

4. Cornicles long and strongly clavate on one side (fig. 184). Antennae shorter than body, with VI spur not longer than III .... **Liosomaphis** Walker

— Cornicles slender and but slightly clavate (fig. 183). Antennae never much shorter than body, with VI spur longer than III (fig. 258) or with a supracaudal tubercle (figs. 255, 256) .... **Siphorcoryne** Passerini

5. Third discoidal vein but one-branched (fig. 276). Body without lateral tubercles. Cauda long and prominent, being about as long as cornicles. **Toxoptera** Koch

— Third discoidal vein twice-branched. Body with or without lateral tubercles. Cauda usually distinctly shorter than cornicles 6

6. Front of head with a very distinct tubercle (figs. 308, 313). Body long without lateral tubercles. Cornicles long and often slightly swollen near apex .... **Myzaphis** Walker and **Coloradoa** Wilson

7. Front of head without prominent tubercle (fig. 233). Body more rounded with lateral tubercles on prothorax and seventh abdominal segment, and oftentimes on some of the anterior abdominal segments .... **Aphis** Linn.

29. Genus **Aphis** Linn.

Linnaeus, Syst. Nat., 1748. Type *Aphis rumicis* Linn.

KEY TO CALIFORNIA SPECIES

Alate viviparous females

1. Abdomen with flocculent masses of wax. Antennae considerably shorter than body, and VI spur shorter than III .... **alamedensis** Clarke

— Abdomen without such flocculent masses of wax (except perhaps *Aphis cooki* Essig) 2

2. Antennae one and one-half times as long as the body, or more. **houghtonensis** Throop

— Antennae not so much longer than body; when longer, which is seldom, but slightly so 3

3. Abdomen pale yellowish green. Found only on *Morus* sp. .... **mori** Clarke

— Abdomen darker being black, dark green, yellow. Not found on *Morus* sp. 4

4. Abdomen dark-green with an orange band between the cornicles. **angelicae** Koch

— Abdomen without such an orange band between the cornicles (sometimes there is a slight orange or reddish coloring between the cornicles of the apterae of *Aphis avenae* Fabr., but it is not constant) 5

5. Abdomen sage-green with faint lateral spots. III with apical one-half conspicuously darkened and with six large sensoria. VI spur less than one-half as long as III. On *Atriplex* spp. .... **tetrapteralis** Cockerell

— Not with above combination of characters 6

6. IV with secondary sensoria (fig. 244) 7

— IV without secondary sensoria (fig. 204) 27

7. Cornicles and hind tarsi subequal 8

— Cornicles considerably longer than hind tarsi 17

8. VI spur shorter than III 9

— VI spur equal to or longer than III 13

9. Cornicles short and tapering 10

— Cornicles short and incrassate .... **pseudobrassicae** Davis

10. V with secondary sensoria. Body slightly pulverulent .... **cooki** Essig

— V without secondary sensoria. Body not pulverulent 11

11. Less than 12 secondary sensoria on III, arranged in a more or less even line 12

— About 20 to 25 secondary sensoria on III, arranged irregularly along segment (fig. 244) .... **senecio** Swain

12. III with 9 to 12 sensoria. V and VI base subequal, each being shorter than IV .... **lithospermi** Wilson

— III with 5 to 9 sensoria. IV and V subequal, each being longer than VI base .... **viburnicolens** n.sp.

13. Cornicles shorter than hind tarsi. A large black species in life being marked with white bars and cross bands on the abdomen .... **albipes** Oestlund

— Cornicles and hind tarsi subequal. Body color greenish 14

14. Root-infesting species. Antennae short, scarcely reaching the middle of the abdomen .... **middletonii** Thomas

— Aërial species. Antennae reaching to base of the cornicles, or as long as body 15

15. Cornicles incrassate. A medium-sized species .... **pseudobrassicae** Davis

— Cornicles cylindrical and tapering slightly. A smaller-sized species 16

16. Cauda shorter than hind tarsi. III with 11 to 15 sensoria scattered irregularly along segment (fig. 294) .... **marutae** Oestlund

— Cauda longer than hind tarsi. III with 5 to 9 more or less evenly arranged sensoria .... **viburnicolens** n.sp.

17. Cornicles equal to or longer than III 18

— Cornicles not as long as III 19

18. Cauda, cornicles, and III subequal. Second branch of third discoidal vein very near to apex of wing .... **spiraecola** Patch

— Cauda considerably shorter than cornicles or III, the last two being subequal. Second branch of third discoidal about midway between base of first branch and apex of wing .... **oenotherae** Oestlund

19. Fore wing with the second branch of the third discoidal arising very near to the apex of the wing. (In a few cases the second branch is not found, but never in both wings) (fig. 191) .... **avenae** Fabr.

— Venation of fore wing normal (fig. 187) 20

20. Antennae longer than body .... **persicae-niger** Smith

— Antennae not longer than body 20

21. A pair of small tubercles present on the middle of the seventh and eighth abdominal segments .... **malifoliae** Fitch

— Such tubercles not present 22

22. V with secondary sensoria. VI spur longer than III 23

— V without secondary sensoria. VI spur at most equal to III 25

23. Beak scarcely reaching second coxae .... **maidis** Fitch

— Beak reaching beyond second coxae, even to or beyond the third 24

24. Cornicles longer than cauda (figs. 194, 195) and more than twice as long as hind tarsi .... **sambucifoliae** Fitch

— Cornicles and cauda subequal; the former not more than twice as long as hind tarsi .... **neomexicana** Cockerell var. **pacifica** Davidson

25. Cauda and hind tarsi subequal. III with a few large sensoria (fig. 232). Abdomen green with dark dorsal markings .... **ramona** Swain

— Cauda longer than hind tarsi. III with several sensoria. Abdomen black or dark brown 26

26. Cornicles more than twice as long as hind tarsi, often almost three times as long. VI spur and cornicles subequal, hind tarsi and VI base subequal. **hederae** Kalt.

— Cornicles never more than twice as long as hind tarsi, usually considerably less. Hind tarsi usually slightly longer than VI base, and VI spur longer than cornicles .... **euonomi** Fabr.

27. Cornicles distinctly knobbed, the tip being widened to twice the width of the rest of the cornicles .... **frigidae** Oestlund

— Cornicles normal 28

28. Fore wing with the second branch of the third discoidal arising very near the apex of the wing (fig. 188) .... **salicicola** Thomas

— Fore wing with venation normal (fig. 187) 29

29. Cornicles distinctly longer than cauda 31

— Cornicles at most equal to cauda 30

30. Cornicles short and swollen throughout apical one-half (fig. 203). Antennae as long as or longer than the body .... **brassicae** Linn.

— Cornicles short and slender, and slightly clavate on one side. Antennae scarcely two-thirds as long as the body .... **atriplicis** Linn.

31. Abdomen without lateral tubercles on anterior segments. Cauda short and broad, with rounded tip, and almost as long as the cornicles .... **cardui** Linn.

— Abdomen with lateral tubercles on at least one of the anterior segments 32

32. VI spur shorter than III 33
— VI spur not shorter than III 34
33. Cornicles about three times as long as cauda .... **medicaginis** Koch
— Cornicles not three times as long as cauda 34
34. Cauda more than one-half as long as cornicles 35
— Cauda not more than one-half as long as cornicles 38
35. III with four or five fairly large sensoria .... **oregonensis** Wilson
— III with many irregular sensoria 36
36. III with 20 or more sensoria, IV with none 37
— III with less than 20 sensoria, usually 14 or 15. IV usually with one or two, or more sensoria .... **euonomi** Fabr.
37. IV about one-third longer than V. Cornicles about four times as long as broad at base. On *Heraclium* spp. .... **heraclii** Cowen
— IV but about one-sixth longer than V. Cornicles about three times as long as broad at base. On *Yucca* sp. .... **Yuccae** Cowen
38. A few (about 10) equal-sized sensoria on III (fig. 222). A large yellow species with distinct dark markings .... **nerii** Fonsc.
— About 20 irregular sensoria on III (fig. 211). Not yellow 39
39. Cornicles slightly more than twice as long as hind tarsi 40
— Cornicles not twice as long as hind tarsi .... **cari** Essig
40. Hind tarsi slightly longer than cauda .... **ceanothi** Clarke
— Hind tarsi shorter than cauda .... **cornifoliae** Fitch
41. VI spur one and one-half or more times as long as III .... **setariae** Thomas
— VI spur never so much longer than III 42
42. III with a few large circular sensoria (5–10) (figs. 226, 290) 43
— III with several (15 or more) irregular sensoria 45
43. Beak reaching to or beyond third coxae. IV never with sensoria. **gossypii** Glover
— Beak not reaching third coxae 44
44. VI spur longer than III (fig. 226). Small size .... **pomi** de Geer
— VI spur subequal to or shorter than III (figs. 289, 290). Medium to large size .... **cerasifoliae** Fitch
45. Cornicles twice as long as cauda. Femora of all three pairs of legs similarly colored .... **cari** Essig
— Cornicles longer than cauda, but not twice as long. Femora of first pair of legs pale, of second and third pair black .... **euonomi** Fabr.

Apterous viviparous females[15]

1. Cornicles shorter than hind tarsi 2
— Cornicles equal to or longer than hind tarsi 4
2. VI spur longer than III. White bars and bands on abdomen in life. **albipes** Oestlund
— VI spur not longer than III. Abdomen not as above 3
3. Cornicles and cauda subequal. Beak not reaching to second coxae. Pulverulent .... **brassicae** Linn.
— Cornicles shorter than cauda. Beak reaching to or beyond second coxae. Not pulverulent .... **atriplicis** Linn.

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[15] In this key only those species are included of which there are specimens in the author's collection or of which there are adequate descriptions available. The following species are therefore omitted: *Aphis alamedensis* Clarke, *A. houghtonensis* Throop, *A. mori* Clarke, *A. neomexicana* Cockerell, *A. oenotherae* Oestlund, and *A. tetrapteralis* Cockerell.

4. Cornicles and hind tarsi subequal 5
— Cornicles longer than hind tarsi 10
5. Secondary sensoria on III and IV. Root species ..... **middletonii** Thomas
— No secondary sensoria. Aërial species 6
6. III longer than VI spur 7
— III shorter than or at most equal to VI spur 8
7. IV and cornicles subequal ..... **lithospermi** Wilson
— IV shorter than cornicles. Pulverulent ..... **cooki** Essig
8. IV and cornicles subequal. Antennae considerably more than one-half the length of the body 9
— IV shorter than cornicles. Antennae at most one-half the length of the body. **senecio** Swain
9. Cornicles twice as long as cauda and slightly swollen before the tip. **avenae** Fabr.
— Cornicles not twice as long as cauda, cylindrical, and tapering toward tip. **marutae** Oestlund
10. Cornicles less than twice as long as hind tarsi 11
— Cornicles twice as long as or longer than hind tarsi 21
11. Secondary sensoria on III and IV. Root-infesting species. **middletonii** Thomas
— No secondary sensoria. Aërial species 12
12. VI spur longer than III 13
— VI spur at most equal to III 16
13. Ground color, black or dark brown 14
— Ground color, a shade of green 15
14. VI spur one and one-half to two times as long as III. Apex only of femora dusky ..... **setariae** Thomas
— VI spur but slightly longer than III. Apical one-half of femora dusky. **medecaginis** Koch
15. Pale green. Cornicles and cauda subequal. Dark, mottled green. Cornicles twice as long as cauda or longer ..... **avenae** Fabr.
16. VI spur considerably shorter than III 17
— VI spur almost as long as III 18
17. Cornicles swollen toward tip ..... **pseudobrassicae** Davis
— Cornicles cylindrical and tapering toward tip ..... **ramona** Swain
18. Cornicles but slightly longer than hind tarsi 19
— Cornicles about one and one-half times as long as hind tarsi 20
19. Dark green. Cornicles at least three times as long as broad at base. **maidis** Fitch
— Pale green. Cornicles at most twice as long as broad at base. **senecio** Swain
20. Dark green to reddish yellow. On *Yucca* spp. ..... **yuccae** Cowen
— Black or very dark brown with black dorsal bands and spots. On various plants ..... **euonomi** Fabr.
21. Cornicles distinctly knobbed at tip ..... **frigidae** Oestlund
— Cornicles normal 22
22. VI spur longer than II 23
— VI spur at most equal to III 25
23. Pale green with dusky dorsal abdominal markings ..... **calendulicola** Monell
— Not colored as above, either not green, or if green with dusky dorsal abdominal markings 24

24. Bright yellow with black markings. Cornicles at least three times as long as hind tarsi .... **nerii** Fonsc.

— Dark green with black markings. Cornicles but about twice as long as hind *tarsi* .... **cardui** Linn.

25. Cornicles longer than III 26

— Cornicles at most equal to III 29

26. III considerably longer than VI spur 27

— III subequal to or but slightly longer than VI spur 28

27. Black. Cornicles about three times as long as hind tarsi. III one and one-half times as long as VI spur .... **sambucifoliae** Fitch

— Green, pale to apple. Cornicles about four times as long as hind tarsi. III almost twice as long as VI spur .... **salicicola** Thomas

28. Cornicles subequal to or but slightly longer than III, and about twice as long as cauda .... **prunorum** Fabr.

— Cornicles one and one-half to two times as long as III, and about four times as long as cauda .... **oregonensis** Wilson

29. Cornicles considerably shorter than III 30

— Cornicles subequal to or but slightly shorter than III 37

30. III and IV spur subequal .... **persicae-niger** Smith

— III longer than VI 31

31. Cornicles at least twice as long as cauda 36

— Cornicles not twice as long as cauda 32

32. Pale green, pulverulent .... **cerasifoliae** Fitch

— Dark green, brown, or black, not pulverulent 33

33. Cornicles about three times as long as hind tarsi 34

— Cornicles not three times as long as hind tarsi 35

34. III with a few small secondary sensoria .... **hederae** Kalt.

— No secondary sensoria .... **cornifoliae** Fitch

35. Cornicles considerably more than twice as long as hind tarsi. Lateral abdominal tubercles only on first and seventh segments .... **heraclii** Cowen

— Cornicles at most but slightly more than twice as long as hind tarsi. Lateral tubercles usually on more than first and seventh segments .... **euonomi** Fabr.

36. Antennae about as long as body. Cornicles more than twice as long as Cauda .... **cari** Essig

— Antennae but about one-half as long as body. Cornicles but about twice as long as cauda .... **gossypii** Glover

37. III considerably longer than VI spur 38

— III and VI spur subequal 40

38. A pair of dorsal abdominal tubercles on sixth and seventh segments. **malifoliae** Fitch

— No dorsal abdominal tubercles on sixth and seventh segments 39

39. Cornicles green, cylindrical, tapering slightly toward tip, and fairly straight. Cauda about one and one-half times as long as hind tarsi. Abdomen without dusky dorsal markings .... **ramona** Swain

— Cornicles black, cylindrical, curved outward. Cauda and hind tarsi subequal. Abdomen with dusky dorsal markings .... **seanothi** Clarke

40. VI spur slightly longer than III. Cornicles and cauda subequal. **viburnicolens** n.sp.

— VI spur slightly shorter than III. Cornicles one and one-half times as long as cauda .... **pomi** De Geer

107. **Aphis alamedensis** Clarke

Clarke, Can. Ent., vol. 35, p. 251, 1903 (orig. desc.).

Record.—Prunus domestica; Berkeley (Clarke).

This is an unknown species described from specimens taken by Clarke on greengage plum in Berkeley. Davidson suggests that it might be *Aphis cardui* Linn. (*pruni* Koch) from its brief description.

108. Aphis **albipes** Oestlund

Figures 198 to 200

Oestlund, Geol. Nat. Hist. Surv. Minn., Bull. 4, p. 52, 1887 (orig. desc.).
Williams, Univ. Neb. Studies, vol. 10, p. 119, 1910 (desc.).
Davidson, Jour. Econ. Ent., vol. 3, p. 376, 1910 (list).

Records.—Symphoricarpus racemosus; Stanford University (Davidson); Congress Springs, Santa Clara County, July, 1915 (McCracken); Berkeley, July, 1915 (Shinji).

This species is found at times curling the leaves of snowberry in the San Francisco Bay region. Dr. McCracken noted in connection with the infestation at Congress Springs, "they are quite prettily patterned with white bars and cross-bars." This is usually enough to distinguish them.

109 **Aphis angelicae** Koch.

Koch, Die Pflanzenläuse, p. 521, 1854 (orig. desc.).
Wilson, Jour. Econ. Ent., vol. 2, p. 348, 1909 (desc.).

Record.—Angelica sp., *Hedera* sp.; California (Wilson).

Wilson reported this species from California, but gave no locality or date. It is unknown to the author.

110. **Aphis atriplicis** Linn.

Linnaeus, Fauna Sweden, p. 1000, 1761 (orig. desc.).
Hayhurst, Ann. Ent. Soc. Am., vol. 2, pp. 88–100, 1909 (desc.).
Davidson, Jour. Econ. Ent., vol. 5, p. 407, 1912 (desc. sexuales apterous viviparae).
Davidson, Jour. Econ. Ent., vol. 7, p. 133, 1914 (desc. fundatrix).

Records.—Chenopodium album, C. murale; San Jose, Walnut Creek (Davidson).

This has been reported twice from pigweed or goosefoot in the San Francisco Bay region, where Davidson states that it is very common. The sexes occur in October. Davidson believes that there is an alternate host, but as to what it might be, he is uncertain. The author has never collected specimens, but has had access to material taken by R. W. Doane on *Chenopodium* in Utah in August, 1916.

111. **Aphis avenae** Fabr.

Figures 191, 201, 202

Fabricius, Ent. Syst., p. 736, 1775 (orig. desc.).
Clarke, Can. Ent., vol. 35, p. 254, 1903. *Nectarophora* (list).
Davidson, Jour. Econ. Ent., vol. 3, p. 377, 1910. *Siphocoryne* (list).
Essig, Pom. Jour. Ent., vol. 3, p. 465, 1911. *A. padi* Linn. (list).
Essig, Pom. Jour. Ent., vol. 4, p. 790, 1912. *A. maidis* Fitch (desc).
Smith, Mon. Bull. Cal. Comm. Hort., vol. 3, p. 116, 1914 (list).
Davidson, Mon. Bull. Cal. Comm. Hort., vol. 6, p. 65, 1917 (note).

Records.—*Graminaceae* (various spp.); California, December to May (Davidson, Essig, Morrison, author): *Phalaris arundinacea;* Stanford University, May to July, 1915: *Dracaena draco;* Stanford University, June, 1915: *Musa sapientum;* San Diego, March, 1916: *Typha latifolia;* (Davidson).

This is an abundant species through the state, occurring during the late winter and spring on grasses and grains, migrating to other hosts as these become ripened and dried.

The life history of this species, according to Davis (U. S. Dept. Agr., Bull. 111, April, 1914), is somewhat as follows:

> The spring colonies on grains and grasses originate from viviparous females which passed the winter on the grains and grasses, or from spring migrants from the apples or related fruits; i.e., the progeny of the aphids hatching from eggs laid the previous fall on such trees. As the weather becomes cooler they seek the lower parts or the roots of wheat and other plants of the grass family, and here pass the winter as viviparous females; or the winged fall migrants from the grain may seek such trees as the apple, where the true sexes are produced.

Undoubtedly the most common method of wintering over in California is on the roots and lower parts of the grains and grasses. This species has never been collected on apples or other related trees in this state, nor have the eggs ever been observed. During the early spring it is found abundantly on the grains and small grasses, in January and February in the southern part of the state, and during April and May in the central part. As the grains ripen and the stalks and leaves become hardened, it seems that the aphids migrate to other varieties of grass which remain soft and green later, as canary grass and reed grass and corn, or even to such hosts as the dragon tree, cat-tail rush, and the banana. But the winter is spent as viviparous females on the grains and grasses.

This species has been confused many times with other species infesting grains, such as *Macrosiphum granarium* (Kirby) and *Toxoptera graminum* (Rond.). As the latter does not occur in this state it cannot be confused here with *Aphis avenae* Fabr. Clarke listed this as *Nectarophora avenae* Fabr., so it appears that he might have had *Macrosiphum granarium* (Kirby) in mind, as it is highly improbable that he could have confused *Aphis avenae* Fabr. with a species of *Macrosiphum* (*Nectarophora*). The cornicles of *avenae* Fabr., the absence of antennal tubercles, and the irregular venation make it quite easily distinguishable. The cornicles are quite short, as compared with a species of *Macrosiphum*, and distinct antennal tubercles are entirely lacking. The third discoidal vein of the forewing is typically twice-branched, but the second is close to the apex of the wing, and sometimes is entirely lacking. The only other species of *Aphis* in this state with this character is *Aphis salicicola* Thomas, found on willows. These two are readily distinguished from each other by the comparative lengths of the cornicles, which are considerably longer in *salicicola* Thomas than in *avenae* Fabr.

112. **Aphis brassicae** Linnaeus

Figures 203, 204

Linnaeus, Syst. Nat., vol. 2, p. 734, 1735 (orig. desc.).
Clarke, Can. Ent., vol. 35, p. 250, 1903 (list).
Davidson, Jour. Econ. Ent., vol. 2, p. 302, 1909 (list).
Davidson, Jour. Econ. Ent., vol. 3, p. 376, 1910 (list).
Davidson, Pom. Jour. Ent., vol. 3, p. 399, 1911 (list).
Essig, Pom. Jour. Ent., vol. 3, p. 523, 1911 (desc.).

Record.—*Cruciferae* (various spp.); throughout California.

During the late winter and spring cruciferous plants are often heavily infested with this species. Of the cultivated plants cabbages and radishes seem to be most heavily infested; while the wild mustard and radish often have the entire flower clusters covered with these aphids. Oftentimes in the colonies of this species are also found *Aphis pseudobrassicae* Davis, *Rhopalosiphum lactucae* (Kalt.), and *R. persicae* (Sulz.). In southern California the colonies are always attacked by the braconid fly, *Diaretus rapae* Curtiss, and a large percentage of the individuals destroyed. As summer comes on these parasites and such predators as syrphids and ladybirds usually get the best of the aphids, which disappear to a large extent until fall.

113. **Aphis calendulicola** Monell

Monell, U. S. Geol. Geog. Surv., Bull. 5, p. 23, 1879 (orig. desc.).
Clarke, Can. Ent., vol. 35, p. 250, 1903 (list).

Record.—*Calendula officinale;* Berkeley (Clarke).

This species has not been recognized since Clarke's report of it on marigold. It is possible that he had *Aphis senecio* Swain, which is very common on marigolds throughout the state.

114. **Aphis cardui** Linn.

Figures 208, 209

Linnaeus, Syst. Nat., vol. 2, p. 735, 1735 (orig. desc.).
Carnes, Mon. Bull. Cal. Comm. Hort., vol. 1, p. 399, 1912. *Aphis pruni* (list).
Davidson, Jour. Econ. Ent., vol. 5, p. 407, 1912 (list).
Patch, Maine Agr. Exp. Sta., Bull. 233, p. 263, 1914 (desc.).

Records.—*Cirsium* sp.; San Jose (Davidson); Berkeley, June, 1915: *Prunus domestica;* Orangevale, Sacramento County (Carnes); Walnut Creek (Davidson); Berkeley, March, 1916 (Essig).

According to Patch this thistle aphid is the same as the one infesting plums and formerly known as *A. pruni* Koch. Both are abundant in the San Francisco Bay region, *pruni* being found in the fall and spring on plum, *cardui* during the summer on thistle. The author has attempted no transfer tests, so accepts Patch's statement as authority for the synonymy. It is certain that structurally these are strictly identical.

115. **Aphis cari** Essig

Essig, Univ. Calif. Publ. Entom., vol. 1, pp. 317–321, 1917 (orig. desc.).

Record.—*Carum kelloggii;* Rutherford, Napa County (Essig); *Angelica tomentosa;* Berkeley (Essig).

Essig recently described this from specimens taken on wild anise in Rutherford. The author has seen cotype specimens, but has never collected the species.

116. **Aphis ceanothi** Clarke

Figures 210, 211

Clarke, Can. Ent., vol. 35, p. 250, 1903 (orig. desc.).
Davidson, Jour. Econ. Ent., vol. 2, p. 302, 1909 (list).
Davidson, Jour. Econ. Ent., vol. 3, p. 377, 1910 (list).
Essig, Pom. Jour. Ent., vol. 3, p. 525, 1911. *Aphis ceanothi-hirsuti* n. sp. (desc.).

Records.—*Ceanothus integerrimus;* Colfax, Placer County (Clarke); Witch Creek, San Diego County, June, 1916: *C. cuneatus;* Stanford University (Davidson), November, 1910 (Morrison), October, 1915 (R. A. Vickerey): *C. thysiflorus;* Bear Creek Gulch, Santa Clara County, April, 1911 (Morrison): *C. hirsuti;* Santa Paula (Essig).

This is a widely distributed species, having been found on *Ceanothus* as far north as Placer County, and as far south as San Diego County. It is seldom abundant, however. The species that Essig described as *A. ceanothi-hirsuti* n.sp. is undoubtedly the same as Clarke described.

117. **Aphis cerasifoliae** Fitch

Figures 288 to 292

Fitch, Rept. Ins. N. Y., vol. 1, p. 131, 1855 (orig. desc.).
Patch, Maine Agr. Exp. Sta., Bull. 233, p. 260, 1914 (desc.).

Record.—*Prunus emarginata;* Wynola, San Diego County, June, 1916.

This aphid was found abundantly curling the terminal leaves of wild cherry near Wynola (3700 feet altitude), San Diego County, in June, 1916. Alate and apterous viviparous females as well as nymphs were abundant in the curled leaves. The apterae and nymphs were slightly pulverulent. This species corresponds very closely to *Aphis cerasifoliae* Fitch as described by Patch (*op. cit.*), although there are some minor differences. Following is a copy of Patch's description of the Maine specimens of this species:

This well defined species is common on both the native choke cherry, *Prunus virginiana,* and the western *P. demissa* Walp. introduced in a nursery row on our campus.

Apterous female.—Head, pale green or water whitish, beak short, extending to second coxae, eyes, antennae with I, II and III concolorous with head, distal half darker to black, III with no sensoria, proportions as shown in figure; prothorax pale green, lateral tubercles present; thorax green with dark green middorsal line, femora and tibiae pale and tarsi black; abdomen pulverulent, pale green with dark green median line and dark green transverse lines between segments, lateral tubercles present, cornicles pale with dusky tips, slender, slightly tapering, and approximately twice the tarsus in length, cauda white with dark tip; conical, being broad at base and abruptly tapering.

Nymphs and pupae are also pulverulent and have dark green middorsal and transverse intersegmental line, though these are not always well defined in the pupa which has two lateral dark green lines on thorax.

Alate female. Head black, beak short, not reaching to second coxae, eyes black, antennae dark, III with from about 12 to 18 large sensoria about the size of the terminal one on V, IV with from none to several sensoria like those on III, proportions of joints as shown in the figure; prothorax green with black transverse band, lateral tubercles present; thorax black, wings iridescent with slender brown veins and large dusky stigma with pointed tip; commonly though not always with second branch very short, abdomen glabrous, rather bright though not vivid green, median line dark green, sutural lines dark green ending in marginal green dots, cornicles dark, cauda green.

Aphis cerasifoliae is gregarious on the ventral surface of the terminal leaves badly curling and deforming them. A copious amount of honeydew is present, and ants are usually found attending a colony of this species.

The specimens from Wynola agree very well with this description, although as stated above, there are a few minor points of difference. However, as Dr. Patch writes: "It seems too close to *cerasifoliae* to give it a distinct name," and "if the appearance *in life* answers my description of *cerasifoliae* I should be inclined to call it that. It happens to be a species as characteristic alive as dead." Following are the notes the author took of its appearance alive, before he suspected its identity: "Alates, apterae and nymphs abundant on terminal leaves curling them badly. Large amount of honeydew and many ants in attendance. Apterae and nymphs pulverulent." These notes agree exactly with Patch's notes, cited above.

Following is a brief description of specimens taken at Wynola on July 8:

Apterous viviparous female.—Prevailing color pale apple green, pulverulent. Head luteous. Thorax and abdomen pale green with middorsal longitudinal stripe darker green. Antennae with the three basal joints luteous, the three apical joints shading into black. Primary sensoria on V and VI, accessory sensoria on VI, no secondary sensoria. III and spur are subequal, or III slightly the longer. IV and V subequal and a little more than one-half as long as III. In some cases IV is slightly longer than V. VI is about one-fourth as long as its spur, longer than I, which in turn is longer than II. The antennae are longer than the body. Cornicles long, slightly tapering, pale with tip dusky, about equal in length to the fifth antennal segment and about twice the length of the hind tarsus. Cauda long, conical, and about two-thirds the length of the cornicles, pale with tip dusky. Lateral tubercles are present on the first and seventh abdominal segments and on one other of the abdominal segments, in some cases on the second, in others on the third, and in others on the fourth.

Measurements (of specimens mounted in Canadian balsam): Body length, 1.5 to 1.53 mm.; body width (abdomen), 0.247 mm.; antennae total, 1.445 to 1.734 mm. (av. 1.6082 mm.); I, 0.085 to 0.117 mm. (av. 0.0987 mm.); II, 0.068 mm.; III, 0.408 to 0.467 mm. (av. 0.4335 mm.); IV, 0.238 to 0.306 mm. (av. 0.272 mm.); V, 0.221 to 0.233 mm. (av. 0.224 mm.); VI, 0.1105 to 0.119 mm. (av. 0.1169 mm.); spur, 0.408 to 0.45 mm. (av. 0.4186 mm.); cornicles, 0.221 to 0.255 mm. (av. 0.2401 mm.); cauda, 0.15 mm.; hind tarsi, 0.12 to 0.135 mm. (av. 0.1275 mm.).

Alate viviparous female.—Prevailing color pale to apple green Head, antennae, thorax, marginal spots on abdomen, cornicles, tip of cauda, femora, and tarsi all black. Antennae (fig. 289, 290) with the usual primary sensoria on V and VI and the usual accessory sensoria on VI. IV without sensoria and III with from 6 to 11 fairly large circular secondary sensoria, the usual number being 8 (fig. 290). In this character it differs most markedly from the Main specimens, which have from 12 to 18 sensoria on III and from none to several on IV. The antennae are slightly shorter than the body although practically of the same length. III is the longest segment, closely followed by the spur, then by IV, V, VI, I and II. III and the spur are subequal, or either one or the other may be slightly the longer. In Patch's drawing V is a little longer than IV. In the California specimen IV is always slightly the longer of the two. In all the California specimens the antennal segments are all a little shorter than in the Maine material. Lateral tubercles are present on the prothorax; they are always present on the seventh abdominal segment, and may be present on any of the first few segments of the abdomen as well. In one case they were observed on the second and seventh segments, in another on the second, third, and seventh, in still another on the fourth, fifth, and seventh, and in a fourth case on the first, second, third, fourth, and seventh segments (fig. 292). The wings and venation are normal, with the second branch of the cubitus arising nearer to the tip of the wing than to the base of the first branch (fig. 291). However, it is not quite so close to the wing tip as in the Maine specimens. The cornicles (fig. 292) are long and cylindrical. They are equal to or slightly shorter than V, and from one and one-half to two times as long as the hind tarsi. The cauda (fig. 292) is more or less ensiform, about one-half as long as the cornicles, reaching to the tip of the cornicles, and subequal to or slightly shorter than the hind tarsi.

Measurements (of specimens mounted in Canadian balsam): Body length, 1.53 to 1.65 mm. (av. 1.585 mm.); width of thorax 0.697 to 0.765 mm. (av. 0.731 mm.), antennae total, 1.568 mm.; I, 0.068 to 0.085 mm. (av. 0.0765 mm.); II, 0.051 mm.; III, 0.331 to 0.408 mm. (av. 0.3644 mm.); IV, 0.238 to 0.289 mm. (av. 0.2817 mm.); V, 0.221 to 0.247 mm. (av. 0.2295 mm.); VI base, 0.085 to 0.111 mm. (av.

0.1015 mm.); VI spur, 0.391 mm.; cornicles, 0.204 to 0.246 mm. (av. 0.2179 mm.); cauda, 0.103 to 0.119 mm. (av. 0.1084 mm.); hind tarsi, 0.136 mm.

118. **Aphis cooki** Essig

Figures 212 to 214

Essig, Pom. Jour. Ent., vol. 2, p. 323, 1910. *Aphis gossypii* Glover (desc.).
Essig, Pom. Jour. Ent., vol. 3, p. 587, 1911 (orig. desc.).

Record.—*Citrus* sp., Pomona (Essig).

In 1909, C. H. Vary, county horticultural inspector in Pomona, found a few orange trees heavily infested with this aphid. Prompt control measures were taken and since then it has never again been observed. Essig first thought it to be *Aphis gossypii* Glover and described it under that name. Later, however, he found it to be an undescribed species, so named it *Aphis cooki* n.sp. after Dr. A. J. Cook.

119. **Aphis cornifoliae** Fitch

Fitch, Cat. Homop. N. Y., p. 65, 1851 (orig. desc.).

Records.—*Cornus pubescens, Sanicula menziesii;* San Francisco Bay region (Davidson).

A species comparing very favorably with this has been taken by Davidson a number of times in the San Francisco Bay region. The fall and winter is spent on dogwood, the summer on gambleweed. Davidson writes as follows:

> This aphid [from *Sanicula*] certainly appears to be very close to what I have called (after Gillette) *cornifoliae*. Moreover, I have noticed that the two plants, dogwood and *Sanicula*, frequently grow near each other and that there appeared to be a migration of alates from the former just about the time there was a migration of the alates to the latter.

This migration took place the latter part of April in 1916.

120. **Aphis crataegifolii** Fitch

Fitch, Cat. Homop. N. Y., p. 66, 1851 (orig. desc.).
Sanborn, Kan. Univ. Sci. Bull. 3, p. 53, 1904 (desc.).
Davidson, Jour. Econ. Ent., vol. 3, p. 377, 1910 (list).

Record.—*Crataegus oxycantha;* San Jose, Palo Alto (Davidson).

This has been reported more or less abundant on hawthorne in the San Francisco Bay region. According to A. C. Baker this is a good and distinct species and not a synonym of *Aphis pomi* De Geer, as formerly believed.

121. **Aphis euonomi** Fabr.

Figures 182, 187, 190, 205 to 207, 236, 237

Fabricius, Syst. Ent., p. 736, 1794 (orig. desc.).

Davidson, Jour. Econ. Ent., vol. 2, p. 302, 1909. *A. rumicis* Linn. (list, in part?).

Essig, Mon. Bull. Cal. Comm. Hort., vol. 4, p. 446, 1915. *A. rumicis* Linn. (list).

Records—Althaea rosea, Berkeley, June, 1915; *Hibiscus moscheutos*, Berkeley, July, 1915: *Maytenus boaria*, Berkeley, July, 1915; *Mesembryanthemum equilaterale*, Stanford University, June, 1915; *Silybum marianum*, Stanford University, July, 1915: *Urtica holoserica*, Menlo Park, San Mateo County, January, 1915: *Calendula officinale*, Orange, February, 1917: *Anthemis* sp., Pasadena, April, 1917: *Papaver* sp., El Cajon, San Diego County, May, 1916 (*Aphis papaveris* Fabr.?): *Vicia faba*, Stanford University (Davidson), Oxnard (Essig, 1915), Montebello, Los Angeles County, December, 1916, Riverside, January to May 1917 (*Aphis fabae* Scop.?): *Rumex* spp., Palo Alto, January, 1912 (Davidson), Stanford University, March, 1912 (Morrison), March, 1915, Ventura County, May, 1917: *Phaseolus* spp., Ventura County, May, 1917 (*Aphis rumicis* Linn.?).

There has been a great deal of confusion regarding the identity of this species of aphid, and as yet its synonomy is not worked out satisfactorily. The following is offered only provisionally by the author. The common black aphid has usually been considered as *Aphis rumicis* Linn., *Aphis euonomi* Fabr. being taken as a synonym, but according to Gillette, Linnaeus' description calls for an aphid "brassy brown in color, and not black according to the popular opinion; and its food plant should be species of *Rumex*." He considers the common black species to be *Aphis euonomi* Fabr., as does Mordwilko in the European form. The author follows these two aphidologists in placing *Aphis rumicis* Linn. of American authors (and later European authors) as a synonym of *Aphis euonomi* Fabr. He (i.e., Gillette) writes, "whether or not it is synonymous with *rumicis* we are not certain, but we very much doubt this being the case." As long ago as 1894, Osborn and Sirrine (Iowa Agr. Sta., Bull. 26, p. 904, 1894) proved that the species which wintered in Iowa on *Euonymus* migrated to *Rumex* and other plants in the summer. In California the author has been unable to find it at any time upon *Euonymus*, although this is a very common ornamental plant, especially in the vicinity of Riverside. This may be due, however, to the mild winter climate of southern California, which permits plant lice to live throughout the winter, thus not necessitating the laying of eggs. Concerning the identity of the California species the author believes the form described briefly below to be *Aphis euonomi* Fabr. The one following is probably the same species, and is the one described as *Aphis papaveris* by Fabricius. The species from *Vicia faba* is probably the species described as *Aphis fabae* Scop., which may be synonymous with *Aphis euonomi* Fabr., but again may not be. The author tried a few transfer tests this spring (1917) with the form from *Vicia,* attempting to colonize it on *Hedera helix* and on *Rumex* spp., with negative results. Of course, this does not prove that it will not colonize on these plants, although the author has come to the conclusion that the *Hedera* species is entirely different, being *Aphis hederae* Kalt. Dr. Patch[16] in her interesting paper on aphid ecology makes the following statement regarding migration tests, which, it seems to the author, it is well to remember when making such tests:

> If an investigator fails in one hundred attempts to colonize thistle with migrants from plum, that will not be a safe reason for him to conclude that he is not working with *Aphis cardui,* or that this thistle aphid has nothing to do with the leaf deformations of the plum in the spring. It has been my experience that negative data with aphids under such conditions are just no data at all. If the structural characters are such as warrant the migration test in the first place, they warrant a patient continuation even in the face of repeated failures.
>
> On the other hand (and this is a most encouraging and stimulating circumstance in connection with aphid migration tests), a single success goes a long way to prove the case. Barring complications, a single success is enough, and repetitions and verifications are needed only as safeguards in that respect.

The third description is from specimens taken on *Rumex* spp. and although slightly different from the one considered as *Aphis euonomi* Fabr., it may be the same, and it may be *Aphis rumicis* Linn., but of this the author is doubtful.

In the bean fields of Ventura County, this black bean aphis is very abundant, and often does considerable damage. In May, 1917, the bean plants were just beginning to appear, and as yet were not infested with the aphis. However, the native dock was quite heavily infested. It seems that the aphis lives over the winter on dock and perhaps on other native plants, migrating in the early summer to the beans. Here it lives throughout the summer, returning to dock when the beans have been harvested and the plants plowed under. Horticultural Commissioner A. A. Brock, of Ventura County, places great hope in the efficiency of *Hippodamia convergens* Guérin as a controlling factor. In the spring of 1917 he collected a vast number of these ladybird beetles in Sespe Canyon and turned them loose in the bean fields just as the aphids were beginning to appear. At the present time the results are unknown.

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[16] Patch, Edith M., Concerning problems in Aphid ecology, Jour. Econ. Ent., vol. 9, pp. 44–51, 1917.

The following brief description was made from specimens collected from the first six host plants listed above, and is the one considered as *Aphis euonomi* Fabr.

Alate viviparous female.—Color apparently black, but on close examination it seems that the ground color is a very dark brown, covered with a blackish tinge, with the following parts decidedly black: head, antennae, thoracic lobes, marginal spots and transverse bands on the abdomen, cornicles, tarsi, coxae, tips of tibiae, and apical one-half to two-thirds of the middle and hind femora. The tibiae and fore femora are pale, appearing whitish in life. The antennae are shorter than the body, III being the longest segment, followed closely by VI spur. In one case VI spur was slightly longer than III and in another equal to III. In all other specimens III was the longer segment. IV and V are subequal, V usually being slightly the shorter. There are from eleven to twenty-one secondary sensoria on III, of irregular size. These are scattered along the whole length of the segment, the distal five or six being in a more or less even line. The usual number is about twelve to fourteen. The number of secondary sensoria on IV range from none to seven, the modal number being two. In one specimen only were sensoria absent from IV; in another, one antenna had seven, the other having two, while in a third, one antenna had five, the other six. When there are more than two or three sensoria, they are all quite small, and can be clearly distinguished only by the higher power of a microscope. Two is the usual number, being located about the middle of the segment. V is usually without secondary sensoria, the primary sensorium being always present, however. In one specimen the antennae had one or two very small secondary sensoria on V, and in another specimen one antenna had one small sensorium, the other none. The usual primary and accessory sensoria are present on VI base. Lateral abdominal tubercles are always present on the seventh segment, usually on the first, and often on the second, third, fourth, or fifth. There are always at least three pair of these tubercles, and oftentimes more. One specimen had tubercles on the first, second, third, fourth, and seventh segments. The cornicles are black, imbricated, and taper noticeably from base to apex. They are quite constant in length, the variation being not more than 0.05 mm. in all the specimens examined. They are about half as long again as the hind tarsi. The cauda is concolorous with the abdomen, short and conical or ensiform, and subequal in length to the hind tarsi. The wings are normal, with the typical *Aphis* venation.

Measurements: Body length, 1.53 to 1.989 mm. (av. 1.74 mm.); width of thorax, 0.68 to 0.918 mm. (av. 0.765 mm.); antennae total, 1.122 to 1.36 mm. (av. 1.272 mm.); III, 0.289 to 0.425 m.m (av. 0.3648 mm.); IV, 0.1955 to 0.272 mm. (av. 0.2266 mm.); V, 0.187 to 0.221 mm. (av. 0.1885 mm.); VI, base 0.102 to 0.136 mm. (av. 0.1119 mm.); VI, spur 0.289 to 0.357 mm. (av. 0.3145 mm.); cornicles, 0.1785 to 0.221 mm. (av. 0.2118 mm.); cauda, 0.136 to 0.162 mm. (av. 0.14875 mm.); hind tarsus, 0.136 to 0.152 mm. (av. 0.1372 mm.).

Specimens taken by the author in May, 1916, on *Papaver* sp. (cultivated poppy) near El Cajon, San Diego County, seem to him to be *Aphis papaveris* Fabr. (Genera Insectorum, p. 303, 1717), and probably are the same as the above species, although they may be different. There are from thirteen to fifteen irregular secondary sensoria on III as above, but IV and V are without secondary sensoria, with one exception, in which there was one small sensorium near the middle of IV. The cauda is equal to the hind tarsi, the cornicles being longer, and about the same comparative length as above. The third antennal segment appears to be longer in comparison than above in some specimens. Lateral abdominal tubercles are present on the first, third, and seventh abdominal segments.

Measurements: Body length, 1.486 to 1.908 mm. (av. 1.711 mm.); width of thorax, 0.595 to 0.765 mm. (av. 0.68 mm.); antennae total, 1.224 to 1.343 mm. (av. 1.2878 mm.); III, 0.323 to 0.374 mm. (av. 0.3536 mm.); IV, 0.2125 to 0.22 mm. (av. 0.2193 mm.); V, 0.187 to 0.204 mm. (av. 0.2024 mm.); VI, base 0.102 to 0.119 mm. (av. 0.1054 mm.); VI, spur 0.255 to 0.34 mm. (av. 0.2992 mm.); cornicles, 0.187 to 0.221 mm. (av. 0.204 mm.); cauda, 0.136 to 0.153 mm. (av. 0.142 mm.); hind tarsus, 0.119 mm.

Specimens taken by the author near Montebello, Los Angeles County, in December, 1916, and in Riverside from January to May, 1917, on *Vicia faba* seem to be somewhat different from the foregoing, yet are very nearly identical. Gillette considers that they might possibly be *Aphis fabae* Scop., which may or may not be synonymous with *Aphis euonomi* Fabr. Superficially, the coloring seems to be the same, although on close observation it appears to be a very dark green in ground color, covered with a blackish tinge. The legs are colored as above, however.

Specimens from *Rumex* appear to have considerably more brown in the ground color than the preceding varieties. Secondary sensoria are located as follows: III, 14 to 24 (av. 18); IV, 4 to 7 (av. 5); V, I to 4 (av. 3). Lateral abdominal tubercles could be found only on the first and seventh segments.

Alate viviparous female.—Measurements: Body length, 1.768 to 2.142 mm. (av. 1.942 mm.); width of thorax, 0.782 to 1.054 mm. (av. 0.918 mm.); antennae total, 1.445 to 1.581 mm. (av. 1.496 mm.); III, 0.357 to 0.408 mm. (av. 0.394 mm.); IV, 0.255 to 0.323 mm. (av. 0.286 mm.); V, 0.204 to 0.255 mm. (av. 0.233 mm.); VI, base 0.136 to 0.153 mm. (av. 0.139 mm.); VI, spur 0.289 to 0.323 mm. (av. 0.306 mm.); cornicles, 0.187 to 0.255 mm. (av. 0.219 mm.); cauda, 0.136 to 0.17 mm. (av. 0.153 mm.); hind tarsus, 0.119 to 0.153 mm. (av. 0.147 mm.).

Apterous viviparous female.—Measurements: Body length, 2.278 to 2.448 mm. (av. 2.3403 mm.); antennae total, 1.309 to 1.598 mm. (av. 1.4382 mm.); III, 0.306 to 0.408 mm. (av. 0.3502 mm.); IV, 0.221 to 0.306 mm. (av. 0.2618 mm.); V, 0.206 to 0.255 mm. (av. 0.238 mm.); VI, base 0.119 to 0.17 mm. (av. 0.1394 mm.); VI, spur 0.289 to 0.34 mm. (av. 0.306 mm.); cauda, 0.17 to 0.204 mm. (av. 0.187 mm.); cornicle, 0.255 to 0.323 mm. (av. 0.289 mm.); hind tarsus, 0.153 to 0.17 mm. (av. 0.167 mm.).

122. **Aphis frigidae** Oestlund

Oestlund, Geol. Nat. Hist. Surv. Minn., vol. 14, p. 46, 1886 (orig. desc.).
Davidson, Jour. Econ. Ent., vol. 7, p. 132, 1913 (desc. stem mother).

Records.—*Artemisia californica;* Walnut Creek, Contra Costa County (Davidson).

In company with *Macrosiphum artemisiae* (Fonsc.) this species is found on sagebrush in the San Francisco Bay region. Wilson reports it from Oregon, so probably it is distributed along the coast from the bay north. In the course of observations in southern California during a period of two years the author has been unable to find any aphids infesting sagebrush.

123. **Aphis gossypii** Glover

Figures 192, 193, 215

Glover, Pat. Off. Rec., p. 62, 1854 (orig. desc.).
Clarke, Can. Ent., vol. 35, p. 250, 1903 (list).
Essig, Pom. Jour. Ent., vol. 1, p. 47, 1909. *Aphis citri* Ashmead (desc.).
Essig, Pom. Jour. Ent., vol. 3, p. 590, 1911 (desc.).
Cook, Mon. Bull. Cal. Comm. Hort., vol. 1, p. 65, 1912 (list).
Carnes, Mon. Bull. Cal. Comm. Hort., vol. 1, p. 398, 1912 (list).
Weldon, Mon. Bull. [illegible] Comm. Hort., vol. 2, p. 597, 1913 (list).
Davidson, Mon. Bu[illegible] Comm. Hort., vol. 6, p. 65, 1917 (note).

Records.—*Cucumis* spp.; Newcastle, Placer County, Watsonville, Santa Cruz County (Clarke); Imperial County (Weldon); San Diego County, June, 1916: *Cucurbita* spp.; Alpine, San Diego County, June, 1916: *Citrus* spp.; Santa Paula, Claremont (Essig), Acampo, San Joaquin County (Carnes), San Diego, March, 1916 (R. R. McLean); Whittier, May, 1917: *Heracleum lanatum;* Berkeley, March, 1915 (Essig): *Begonia;* Stanford University, February, 1912 (Morrison), Riverside, January, 1917; *Punica granatum,* Stanford University, April, 1911 (Davidson): *Helianthus;* Santa Ysabel, San Diego County, May, 1916: *Persea gratissima;* Avondale, San Diego County, August, 1916; *Chrysanthemum;* Ontario, January, 1917; *Eschscholtzia californica;* Ontario, January, 1917: *Anthemis* spp.; Pasadena, April, 1917 (R. E. Campbell): *Pyrus* spp.; Santa Cruz County (Volck), Nevada County (Norton).

The melon or cotton aphis is distributed throughout the state and is found on a large number of host plants. On melons it is often a considerable pest, particularly in the Imperial Valley. In the apple sections of Santa Cruz and Nevada counties it often becomes abundant enough upon the young trees to cause considerable damage, according to County Horticultural Commissioners Volck and Norton. In San Diego County the author found an infestation on young avocado trees which was very severe. Oftentimes it becomes quite abundant in nurseries and greenhouses.

124. **Aphis hederae** Kalt.

Kaltenbach, Monog. d. Pflanzenläuse, p. 89, 1843 (orig. desc.).
Davidson, Jour. Econ. Ent., vol. 2, p. 302, 1909. *A. rumicis* Linn. (list in part).
Essig, Pom. Jour. Ent., vol. 2, p. 335, 1910 (desc.).
Davidson, Jour. Econ. Ent., vol. 3, p. 376, 1910. *A. rumicis* Linn. (list).

Records.—*Hedera helix;* Stanford University (Davidson), March, 1912 (Morrison); Claremont, Los Angeles County (Essig); San Jose, May, 1911 (Davidson, Morrison); Oakland, November, 1916 (Davidson); Berkeley, April, 1915; Lemon Grove, San Diego County, March, 1916; Riverside, October, 1916: *Chenopodium* sp., Walnut Creek, Contra Costa County, May, 1915 (Davidson).

Throughout the San Francisco Bay region and southern California a small dark brown to black aphid is often found in colonies on the tender shoots of English ivy. Essig described it as *Aphis hederae* Kalt., but later it was believed to be *Aphis rumicis* Linn. (*A. euonomi* Fabr.). However, a careful study of a large series of specimens of this aphid from ivy and of *A. euonomi* Fabr. from a number of different host plants has convinced the author that they are distinct. Gillette is of the same opinion. Consequently the species from ivy in California is *Aphis hederae* Kalt. In the author's collection there is a specimen from *Chenopodium* sp. taken by Davidson that appears to be the same species. The most noticeable difference between this and *Aphis euonomi* Fabr. is in the length of the cornicles, which are very much longer in this species. Measurements of specimens of the alates from Oakland, Walnut Creek, San Jose, and Riverside are herewith given:

Measurements: Body length, 1.411 to 1.768 mm. (av. 1.621 mm.); width of thorax, 0.714 to 0.782 mm. (av. 0.748 mm.); antennae total, 1.411 to 1.549 mm. (av. 1.499 mm.); III, 0.323 to 0.391 mm. (av. 0.365 mm.); IV, 0.272 to 0.323 mm. (av. 0.2914 mm.); V, 0.221 to 0.272 mm. (av. 0.2518 mm.); VI, base 0.119 to 0.136 mm. (av. 0.311 mm.); VI, spur 0.306 to 0.34 mm. (av. 0.323 mm.); cauda, 0.136 mm.; cornicle, 0.306 to 0.34 mm. (av. 0.3252 mm.); third tarsus, 0.119 to 0.136 mm. (av. 0.1237 mm.).

It will be seen that the cornicles are considerably more than twice as long as the hind tarsi, in some cases practically three times, while in *A. euonomi* Fabr., they are scarcely twice as long as the hind tarsi. In *A. euonomi* Fabr. the hind tarsi are longer than the base of VI, while the cornicles are shorter than VI spur. In *A. hederae* Kalt. VI spur and the cornicles are subequal or on the average the cornicles are very slightly longer, while VI base and the hind tarsi are also subequal, the tarsi being shorter on the average. The secondary sensoria in *A. hederae* Kalt. are small, irregular in size, and are scattered more or less irregularly along III but in a fairly even row along IV and V. They appear very much the same as in *A. euonomi* Fabr. There are from thirteen to twenty on III, seventeen being the average; from five to nine on IV, seven and eight being the usual number; and usually one on V, although in a few cases there appear to be none.

125. **Aphis heraclei** Cowen

Cowen, Hemip. Colo., p. 120, 1895 (orig. desc.).
Essig, Univ. Calif. Publ. Entom., vol. 1, p. 339, 1917 (list).

Record.—Heracleum montezamum; Berkeley (Essig).

Recently Essig reported having taken this species on *Heracleum* in Berkeley. The author has specimens from Essig, although he has never collected it himself. This is the only report of the species since Cowen's original report and description.

126. **Aphis houghtonensis** Troop?

Troop, Ent. News, vol. 17, p. 59, 1906 (orig. desc.).
Davidson, Jour. Econ. Ent., vol. 7, p. 132, 1914 (list).

Record.—Ribes sanguineum; Contra Costa County (Davidson).

Davidson reported a species of *Aphis* infesting the terminal leaves of wild currant in the canyons of Contra Costa County. He identified it provisionally as this species as he was uncertain. The author is unacquainted with it.

127. **Aphis lithospermi** Wilson

Wilson, Trans. Am. Ent. Soc., vol. 41, p. 100, 1915 (orig. desc.).

Record.—*Lithospermum pilosum;* California (Wilson).

There is no definite record of this species in California, but it is listed here because Wilson added it to a list of the California Aphididae submitted to him by the author.

128. **Aphis maidis** Fitch

Figures 216 to 218

Fitch, Insects N. Y., vol. 1, p. 318, 1855 (orig. desc.).
Clarke, Can. Ent., vol. 35, p. 251, 1903 (list).
Davidson, Jour. Econ. Ent., vol. 5, p. 408, 1912 (list).

Records.—Corn; Watsonville, Berkeley (Clarke); San Jose (Davidson); Lakeside, San Diego County, April, 1916; Chula Vista, San Diego County, August, 1916: sorghum; Julian, San Diego County, August, 1916 (H. M. Armitage); Corona, Riverside County, September, 1916.

Only occasionally is this corn aphis found in California, where it infests the ears and tassels and leaves of corn and some of the sorghums. Never has it been observed as injurious as is sometimes reported from the middle western states.

129. **Aphis malifoliae** Fitch

Figures 248 to 250

Fitch, Trans. N. Y. State Agr. Soc., vol. 5, p. 14, 1854 (orig. desc.).
Clarke, Can. Ent., vol. 35, p. 252, 1903. *Aphis sorbi* Kalt. (list).
Carnes, Mon. Bull. Cal. Comm. Hort., vol. 1, p. 400, 1912. *A. sorbi* Kalt. (list).
Weldon, Mon. Bull. Cal. Comm. Hort., vol. 3, p. 188, 1914. *A. sorbi* Kalt. (list).
Baker and Turner, Jour. Agr. Res., vol. 7, pp. 321–343, 1916 (complete account).

Records.—*Pyrus malus, P. communis;* Central and northern California; Orange County, May, 1917.

This is one of the most injurious of our California species of *Aphis*, being found in practically all of the apple-growing regions of the state, and in most of them necessitating some control measures. It has been reported on apple and pear in the following counties: Humboldt, Orange, Placer, Sacramento, Santa Clara, Shasta, Tehama, Nevada, Inyo, Santa Cruz, and Alameda. Probably it is present wherever apples are grown, with the exception of the southern California districts where it has never been observed. The apple is the primary host, and only occasionally has it been taken on pear. In May, 1917, Roy K. Bishop found it in Orange County, this being the first report of it south of the Tehachapi.

The life history of this *Aphis* in California is as follows:

In the fall and early winter the eggs are laid in the crotches of the twigs. These hatch in the following spring, the exact time depending upon the weather conditions but it is usually as the buds are beginning to show green, or as they are beginning to open. The author has observed the young stem mothers on the young buds of the apple in the latter part of March, although he has never been able to find the eggs, either those yet unhatched or those from which the stem mothers have already hatched. Horticultural Commissioner Weatherby of Humboldt County writes that he has found the eggs hatching as early as February 24. He goes on to state that the eggs of *Aphis pomi* De Geer do not hatch until considerably later. Horticultural Commissioner Norton of Nevada County has made the following observations:

> The eggs of *Aphis sorbi* [*malifoliae*] are laid on the buds, or sometimes on the spurs close to the buds. At first they are hard to see as they are small and light green, but later they turn to a shiny black, when they can be more readily detected. The young aphids hatch as soon as the buds begin to swell, which time varies with the season. I have found them sometimes as early as the first of March and at other times as late as the middle of April.

The stem mothers feed upon the plant juices through the buds, sometimes appearing on the outer surface of the buds and at other times crawling down into the unfolding leaves, as is the case with *Aphis pomi* De Geer. In a few weeks these are mature and begin to deposit live young. All of this second generation are apterous females so far as the author has been able to observe. On April 12, 1915, he found several colonies of these aphids in the apple orchard at Stanford University, each colony consisting of a stem mother and several young apterous viviparous females. These females mature in a few weeks and a third generation is begun. The most usual place to find the second and third generations is in the curled terminal leaves of the plant. These leaves are curled very similarly to those by the green apple aphis (*Aphis pomi* De Geer), but they are curled a great deal tighter. Winged females may appear in this third generation, but it is most usual to find them in the fourth. Horticultural Commissioner Volck of Santa Cruz County states that he has counted four generations before the summer migration. During May, 1915, the author collected many colonies of this *Aphis* and placed them in vials in the laboratory. Many others he attempted to colonize on some apple seedlings. Owing to various causes he was unable to make any successful colonizations on the apple trees, one of the chief causes being the destructive work of coccinellid larvae. Also during the first few days of June he was forced to be absent from town and on his return found that the gardener had "cleaned" the trees, for "they were all covered with lice." Until May 25 no alate females had been found, but on that date two appeared in the laboratory. On May 10, 1917, alates were found in Orange County.

These alate females of the fourth (perhaps sometimes they appear in the third) generation migrate from the apple to some unknown host. At Stanford University in 1915 the migration began about the first of June and continued for some two or three weeks. On June 20 only two or three colonies, each consisting of but a very few individuals, were found where a month before there had been literally hundreds. The curled leaves still hung on the trees and in each curled leaf the moulted skins of the aphid were abundant. From Commissioner Norton of Nevada County comes the statement that he has known the migrants "to leave the trees as early as the middle of June, but the migration usually takes place between the first and the fifteenth of July. Where they go I have never been able to find out, as I have never observed them on any other host plant."

According to O. E. Bremner, Horticultural Commissioner of Sonoma County, the migration takes place there during June. This is the same as in Santa Clara County. In Orange County in 1917 the alate females appeared about the first of May. Migration began almost immediately and continued for two or three weeks. By May 24 only a very few aphids remained. This is fully a month earlier than migration takes place north of the Tehachapi. Incidentally the spring of 1917 was exceedingly cool and the summer very late. In normal years one would expect the aphids to leave the apple two or three weeks earlier.

The summer host plant of this aphid is as yet unknown in California. During June, 1915, the author spent many hours in search of this host plant, but to no avail. He examined every kind of plant within two or three hundred yards of the apple orchard at Stanford University, but on none was he able to find any aphid that could possibly be the summer form of *Aphis malifoliae* Fitch. Bremner reports having found isolated individuals on pigweed (*Amaranthus retroflexus*) in Sonoma County, but believes this to be accidental for he has never observed them to deposit young on this plant. Davidson writes that he has been able to colonize them in the laboratory on the leaves of plantain (*Plantago* spp.), in fact has been able to have them reproduce in such large numbers as to kill the plants. On May 28, 1915, the author placed two alate females from apple leaves on each of two specimens of *Plantago hirtella* under bell jars in the laboratory at Stanford University. On returning to town on June 10 he found that the plants were in a dying condition, owing to a lack of proper care during his absence. However, he found many young lice present, all of which were alive and feeding. The adult alate females had already died. By June 16 the lice had moulted once, but then the plants were practically dead. He left Stanford within a few days not to return, so was unable to begin fresh experiments along this line. In his search for the alates in the field he was particularly careful to examine closely every plantain plant in the vicinity, but could find no trace of this aphid on them. Davidson also reports the same lack of success. Consequently, although the alates will deposit young on plaintain in the laboratory it cannot very well be the natural summer host in this state. Baker and Turner have proven that *Plantago lanceolata* is the summer host in Virginia. W. H. Britain has observed a definite migration to plaintain in Nova Scotia (Proc. Ent. Soc. Nova Scotia, vol. 1, pp. 16–30, 1915). Incidentally he has been able to breed it throughout the summer on apple. In Orange County, in the vicinity of the known infestations, the author was unable to find any plaintain whatsoever. On inquiring of Roy K. Bishop, the county horticultural commissioner, it was learned that plaintain is very scarce in that county, except very near to the coast, and that it is exceedingly doubtful if there is any in the vicinity of the known aphid infestations.

The fall migrants begin to return to the apple some time during the fall and deposit living males and females. From Nevada County comes the report that the migrants return to the apple "between the twentieth of September and the first of October." Davidson has taken the oviparous females and the alate males on December 5 (1912) at

Sebastopol; Morrison has taken the sexes at Stanford University on December 16 (1910); Moznette of the Oregon station has taken the migrants as late as the middle of November at Corvallis, Oregon. Consequently, egg laying probably occurs from the middle of October well into December in the various parts of California. Commissioner Norton states: "The first eggs that I have seen were observed about the fifteenth of October. However, they continue egg laying, in favorable years, well along into November."

The injury caused by this aphid is done entirely in the spring of the year, before the summer migration, and consists in the curling of the terminal leaves. The colonies are found usually in the leaves surrounding a cluster of apples, and although most of the feeding is on the leaves themselves oftentimes they feed upon the fruit. In such a case the fruit (according to Weldon, "Apple Growing in California," Mon. Bull. Cal. Comm. Hort., p. 86, 1915) "is injured to such an extent that it becomes stunted and not only fails to mature, but is distorted so badly that the variety may not be recognizable." In Nevada County, Commissioner Norton reports: "The purple aphis unless controlled lessens the apple crop from ten to fifteen per cent." This is a higher percentage, undoubtedly, than is common throughout the state, but it shows how serious the pest may be.

130. **Aphis marutae** Oestlund

Figures 293 to 299

Oestlund, Minn. Geol. Nat. Hist. Surv., vol. 14, p. 40, 1886 (orig. desc.).

Records.—Silybum marianum; Grossmont, San Diego County, April, 1916: *Centaurea melitensis;* El Cajon, San Diego County, May, 1916.

In April, 1916, the author observed a small aphid on milk thistle near Grossmont, San Diego County, and later on *tacalote* in the El Cajon Valley. It infested the smaller leaves, the leaf petioles, and the base of the flowers. Large numbers of ants were in attendance, but it was preyed upon extensively by the larvae and adults of *Coccinella californica.* A considerable number of adults of *Lysiphlebus testaceipes* Cresson were reared from colonies of this aphid. Being unknown to the author specimens were sent to J. J. Davis and E. O. Essig, both of whom determined the species to be *Aphis marutae* Oestlund. Inasmuch as Oestlund's descriptions are the only ones available, a brief description is given below of specimens taken May 1, 1916, on *Silybum marianum* in San Diego County.

Alate viviparous female.—Prevailing color pale to olive green. Head and prothorax dark olive green, thoracic lobes almost black. Abdomen pale green with marginal spots and patch on dorsum dusky. Legs pale except tarsi, apex of tibiae, and apical two-thirds of femora. Antennae, cornicles, and cauda dusky. Beak pale at base and dusky at tip.

Head (fig. 293) not quite as long as broad, with a prominent tubercle at apex of front and small but distinct projections from head on inner side of first antennal segments. Antennae about same length as body or slightly longer or slightly shorter (figs. 294–295). III and the spur are about equal or III slightly longer, never shorter than spur. IV about one-half as long as III. V either shorter or equal to IV. VI shorter than V and about one-third as long as spur. I and II subequal and slightly shorter than VI. The usual primary sensoria are present on V and VI and the accessory sensoria on VI. III is tuberculate and IV is slightly so. IV has from two to six small, circular secondary sensoria and III from eleven to fifteen irregularly placed (fig. 294). The beak reaches considerably beyond the second coxae, in some cases almost to the third.

The prothorax is without lateral tubercles. The wings are about twice as long as the body with normal venation. The stigmal vein is curved its entire length, the second branch of the cubitus arises about midway between the tip of the wing and the base of the first branch.

The abdomen is without lateral tubercles in so far as the author can discern. The cornicles (fig. 299) are short and taper slightly from base to apex. They are about equal in length to the third tarsi, are almost one-half as wide at base as long, and about one-third as wide at apex as long. The cauda (fig. 298) is short and blunt (conical) and about two-thirds as long as the cornicles. The anal plate is half-moon-shaped and dusky at its distal edge.

Measurements (of specimens in Canada balsam): Body length, 0.918 to 1.02 mm. (av. 0.9248 mm.); width (thorax), 0.34 to 0.442 mm. (av. 0.4082 mm.); antennae total, 0.885 to 1.02 mm. (av. 0.942 mm.); I, 0.034 to 0.051 mm. (av. 0.037 mm.); II, 0.034 to 0.051 mm. (av. 0.048 mm.); III, 0.225 to 0.2975 mm. (av. 0.2601 mm.); IV, 0.117 to 0.17 mm. (av. 0.152 mm.); V, 0.1105 to 0.136 mm. (av. 0.1346 mm.); VI, 0.068 to 0.102 mm. (av. 0.0833 mm.); spur, 0.204 to 0.272 mm. (av. 0.2295 mm.); cornicles 0.0850 to 0.119 mm. (av. 0.0978 mm.); cauda, 0.0595 to 0.068 mm. (av. 0.0624 mm.); hind tarsi, 0.085 to 0.102 mm. (av. 0.0901 mm.); wing length, 1.921 to 1.955 mm. (av. 1.928 mm.); wing width, 0.661 mm.; wing expansion, 4.556 mm.

Apterous viviparous female.—The apterae are quite similar to the alates except that the thorax is not dark, and that the second, third, and basal three-fourths of the fourth antennal segments are pale. There are no secondary sensoria (fig. 296) and no lateral tubercles on prothorax and abdomen (fig. 297). The individuals are slightly larger and the proportions of the antennal segments differ slightly from the alates. The measurements of specimens mounted in Canada balsam are as follows:

Measurements: Body length, 1.00 to 1.04 mm. (av. 1.026 mm.); width (abdomen), 0.595 to 0.629 mm. (av. 0.6064 mm.); antennae total, 0.561 to 0.697 mm. (av. 0.6151 mm.); III, 0.102 to 0.136 mm. (av. 0.1218 mm.); IV, 0.0765 to 0.1105 mm. (av. 0.0906 mm.); V, 0.068 to 0.085 mm. (av. 0.0765 mm.); VI, 0.595 to 0.0765 mm. (av. 0.068 mm.); spur, 0.1615 to 0.1785 mm. (av. 0.1711 mm.); cornicles, 0.0765 to 0.11 mm. (av. 0.0935 mm.); cauda, 0.0595 mm.; hind tarsi, 0.102 mm. (Description from nine specimens of apterae). It will be noticed that in the apterae the antennae are but about two-thirds as long as the body, while in the alates they are almost as long as the body. Furthermore, in the apterae the spur of the sixth antennal segment is always longer than III while in the alates it is equal to III at the most, and in many cases shorter.

131. **Aphis medicaginis** Koch

Figure 189

Koch, Die Pflanzenläuse, p. 94, 1854 (orig. desc.).
Davidson, Jour. Econ. Ent., vol. 2, p. 302, 1909 (list).
Davidson, Jour. Econ. Ent., vol. 3, p. 376, 1910 (list).
Essig, Pom. Jour. Ent., vol. 3, p. 527, 1911 (desc.).

Records.—*Medicago hispida;* Stanford University (Davidson), April, 1914 (R. W. Haegele): *Astragalus leucopsis;* Nordhoff, Ventura County (Essig): *Vicia faba,* lima bean, Pasadena (R. E. Campbell).

This small dark Aphis has been found occasionally in California, particularly on alfalfa and beans. Such other plants as loco weed, licorice, sagebrush, locust, and others are said to be hosts. The author has never collected it himself, but has had access to specimens taken by Essig, Haegele, and Campbell. Davidson has reared the braconid fly, *Lysipheebus testaceipes* Cresson, from this aphid.

132. **Aphis middletonii** Thomas

Figures 219, 220

Thomas, 8th Ann. Rep. Ill. St. Ent., p. 99, 1879 (orig. desc.).

Records.—*Amaranthus retroflexus;* Santa Paula, August, 1911 (Essig): *Ranunculus californicus;* Julian, San Diego County, June, 1916: *Hemizonia rudis;* Stanford University, 1916 (Ferris): *Helianthus annuus;* Riverside, September, 1916.

In the fall of the year this species is rather common on the roots of various plants in California. The individuals are small green aphids, covered with a slight pulverulence. They are very similar to *Aphis maidis-radicis* Forbes, with which they have often been confused, and differ particularly in the presence of secondary sensoria on the fourth antennal segment of the apterae. Below are a few descriptive notes taken from specimens mounted in balsam, collected in 1916 in Julian and Riverside, and in 1911 near Santa Paula:

Alate viviparous female.—Greenish, pruinose. Head, antennae, thorax, marginal spots on abdomen, cornicles, cauda, apical one-half femora, apices tibiae, tarsi, and apex of beak, black. Antennae reach to the base of the second abdominal segment; III being the longest segment, followed by VI spur. IV and V are subequal, VI base slightly shorter. The usual primary and accessory sensoria are present. Secondary sensoria occur on III and IV (fig. 220). There are nine to twelve on III, and one to four on IV. The average numbers are eight and two respectively. The beak reaches to the third coxae. Prominent lateral tubercles are present on the first and seventh abdominal segments, as well as on the prothorax. The cornicles are short and taper slightly toward the apex. They are subequal in length to the hind tarsi, and very slightly larger than the cauda. The wings are normal, with the second branch of the third discoidal arising nearer to the apex of the wing than to the base of the first branch.

Measurements: Body length, 1.65 to 1.7 mm. (av. 1.674 mm.); width of thorax, 0.561 mm.; antennae total, 0.816 to 0.918 mm. (av. 0.884 mm.); III, 0.204 to 0.255 mm. (av. 0.2338 mm.); IV, 0.11 to 0.119 mm. (av. 0.1169 mm.); V, 0.11 to 0.136 mm. (av. 0.1275 mm.); VI, base 0.085 to 0.102 mm. (av. 0.0986 mm.); VI, spur 0.204 mm.; cauda, 0.102 mm.; cornicles, 0.1275 to 0.136 mm. (av. 0.1332 mm.); hind tarsus, 0.119 to 0.136 mm. (av. 0.1303 mm.); wing length, 1.904 to 2.38 mm. (av. 2.159 mm.); width, 0.731 to 0.85 mm. (av. 0.815 mm.); expansion, 4.3 to 5.1 mm. (av. 4.717 mm.).

Apterous viviparous female.—These are very similar to the alate females, only slightly larger. The antennae are dusky throughout except the base of III. They reach to the base of the first abdominal segment. III is the longest segment. VI spur is next, being about two-thirds as long. IV, V, and VI base are subequal, with V somewhat shorter than the others. The usual primary and accessory sensoria are present on V and VI. III has two or three small secondary sensoria located in the apical one-third of the segment. IV has from one to three in the apical one-half. The prothorax and the first and seventh abdominal segments each have a pair of conspicuous lateral tubercles. The cornicles are black and somewhat larger than in the alates, being slightly longer than the hind tarsi. The cauda is a little shorter than the hind tarsi.

Measurements: Body length, 1.632 to 1.785 mm. (av. 1.708 mm.); width of thorax, 0.748 to 0.85 mm. (av. 0.799 mm.); antennae total, 0.867 to 0.969 mm. (av. 0.9265 mm.); III, 0.2465 to 0.289 mm. (av. 0.2635 mm.); IV, 0.102 to 0.136 mm. (av. 0.119 mm.); V, 0.102 to 0.119 mm. (av. 0.1105 mm.); VI, base 0.119 mm.; VI, spur 0.1615 to 0.187 mm. (av. 0.17 mm.); cornicles, 0.153 to 0.17 mm. (av. 0.1615 mm.); cauda 0.119 mm.; hind tarsus, 0.136 mm.

133. **Aphis mori** Clarke

Clarke, Can. Ent., vol. 35, p. 251, 1903 (orig. desc.).

Record.—*Morus* sp., Berkeley (Clarke).

This is a rather doubtful species, described by Clarke from specimens taken on mulberry in Berkeley. Since the original description it has never again been observed.

134. **Aphis neomexicana** Ckll. var. **pacifica** Dvdn.

Figures 300, 302

Davidson, Jour. Econ. Ent., vol. 10, p. 293, 1917 (orig. desc. var.).

Records.—*Ribes rubrum;* Walnut Creek, Contra Costa County, and San Jose (Davidson).

Davidson described this variety from specimens found curling the leaves of cultivated red currant in Walnut Creek in June, 1915. What he takes to be the same species he had already collected in San Jose in May, 1912. The author has specimens from him, but has never collected any himself.

135. **Aphis nerii** Fonsc.

Figures 221, 222

Boyer de Fonscolombe, Ann. Ent. Soc. France, vol. 10, p. 167, 1841 (orig. desc.).

Davidson, Jour. Econ. Ent., vol. 3, p. 377, 1910 (list).

Davidson, Jour. Econ. Ent., vol. 3, p. 377, 1910. *A. lutescens* Monell (list).

Davidson, Pom. Jour. Ent., vol. 3, p. 399, 1911. *A. lutescens* Monell (list).

Essig, Pom. Jour. Ent., vol. 3, p. 401, 1911. *A. lutescens* Monell (desc.).

Essig, Pom. Jour. Ent., vol. 3, p. 530, 1911 (desc.)

Branigan, Mon. Bull. Cal. Comm. Hort., vol. 4, p. 53, 1915 (list).

Records.—Asclepias mexicana; Stanford University (Davidson); Stanford University, October, 1910 (Morrison); Penryn, Placer County (Davidson); southern California (Essig); Berkeley, July to September, 1915: *Nerium oleander;* southern California (Essig); Sacramento (Branigan); Berkeley, August to December, 1915; San Diego, 1916.

In the late spring, summer, and early fall milkweeds throughout the state are often seen to be infested with a bright yellow and black aphid. In the fall and early winter this same species is found infesting oleanders. Where oleanders are present but no milkweeds this aphid can be found from spring until winter on the oleander, as observed during 1916 in San Diego.

Heretofore the species on oleander and milkweed have been considered as distinct, the former being called *A. lutescens* Monell, the latter *A. nerii* Fonsc. According to a note from J. J. Davis the species on milkweed could not be *A. lutescens* Monell. Following are extracts from his letters concerning this point:

> I am wondering whether you have ever found winged specimens on *Asclepias* that do not bear the black markings at the base of the cornicles. All the specimens that I have collected and which Mr. Monell has collected in recent years have these black markings at the base of the cornicles in the winged forms. However, in referring to an old note from Mr. Monell, he says that it would seem hardly possible that he could have missed these dark spots if they had been present in the specimens from which he drew his description for *Aphis lutescens,* and remarks further that he is not sure that he has ever seen *A. lutescens* alive since he first described it. I am wondering if *lutescens* is not really *asclepiadis* of Passerini and whether our other common species on *Asclepias* and *Nerium* is not *nerii* Fonsc.

During the summer of 1915 the author found this species on *Asclepias* in the Botannical Gardens at the University of California. During July and August it was quite abundant; in fact, it was especially thick on the stems and undersides of the leaves and blossoms. However, in the latter part of August it seemed to be getting less and less numerous. No sign of parasites was present, and the predaceous enemies were not more abundant than usual, so a search for the cause was made. Within fifty feet of the milkweed plants several oleanders were found and on them was noticed a large yellow species of *Aphis*. This supposedly was *Aphis nerii* Fonsc. In the laboratory the author could find no structural difference whatsoever between this species and the one on *Asclepias*, so he continued to watch them carefully on the hosts. As the days passed the *Asclepias* became freer and freer of the infestation, while the *Nerium* became more and more heavily infested. This continued through September and into October, by which time the *Asclepias* had died down and incidentally no aphids were left. The *Nerium* was very heavily infested then. This was taken as a good proof that these were the same species. Later Essig told the author that the summer before (1914) he had made transfer tests in the laboratory of specimens from *Asclepias* to *Nerium* and that they thrived there and bred well. This fact and the observations above mentioned were noted in a letter to Davis. Following is his answer:

> I have your letter relative to *Aphis asclepiadis* and *nerii*, and am interested in your observations. In 1914, Theobald described a species under the name of *Aphis nigripes*, which he now places as a variety of *asclepiadis*. He considers *nerii* as distinct from *asclepiadis* because the latter lacks the black patches at the base of the cornicles. Passerini's *asclepiadis* is entirely different from Fitch's *Aphis asclepiadis*. Fitch's name has priority for, as you will notice, it was described in 1851. This being the case, Passerini's name will have to fall and be replaced by *Aphis lutescens* of Monell, which according to Mr. Monell's data does not bear the black patches around the base of the cornicles.

This would seem to indicate that the California species on *Asclepias* is *Aphis nerii* Fonsc. and not *A. lutescens* Monell, as brought out by Essig's experiment and by the author's observation. Consequently this Californian species is *Aphis nerii* Fonsc., with *Asclepias* for its summer host and *Nerium* for the winter host.

136. **Aphis oenotherae** Oestlund

Oestlund, Minn. Geol. Nat. Hist. Surv., Bull. 4, p. 62, 1887 (orig. desc.).
Clarke, Can. Ent., vol. 35, p. 252, 1903 (list).

Record.—Oenothera bectiana; Epilobium sp., Berkeley (Clarke).

In 1903 Clarke recorded finding this species on primrose and willow herb in Berkeley. Since then it has not been observed in California. The author has had the opportunity to study specimens from Minnesota, taken by A. C. Maxson.

137. **Aphis oregonensis** Wilson

Wilson, Trans. Am. Ent. Soc., vol. 41, p. 92, 1915 (orig. desc.).

Record.—Artemisia tridentata, California (Wilson).

Wilson stated to the author that he had taken this species in California although he gave no locality or date records. On the strength of his statement it is included among the California aphids. The author has never seen specimens of it.

138. **Aphis persicae-niger** Smith

Figures 223, 224

Smith, Ent. Am., p. 101, 1890 (orig. desc.).
Clarke, Can. Ent., vol. 35, p. 252, 1903 (list).
Gillette, Jour. Econ. Ent., vol. 1, p. 308, 1908 (desc.).
Weeks, Mon. Bull. Cal. Comm. Hort., vol. 1, p. 244, 1912 (list).
Jones, Mon. Bull. Cal. Comm. Hort., vol. 1, p. 318, 1912 (list).
Carnes, Mon. Bull. Cal. Comm. Hort., vol. 1, p. 399, 1912 (list).
Wood, Mon. Bull. Cal. Comm. Hort., vol. 2, p. 570, 1913 (list).

Records.—Prunus spp.; throughout California.

This species is ordinarily found infesting the tender twigs and leaves of peach in the spring and early summer. Occasionally it is found on nectarine, plum, and cherry. There are two records of its occurrence on cherry known to the author; one in San Jose in May, 1912, by Davidson, and one in El Cajon, San Diego County, in May, 1916, by the author. Definite reports of its presence on peach come from Los Angeles, Placer, Riverside, San Benito, San Bernardino, San Diego, Santa Clara, and Tehama counties. In May, 1916, the author observed it doing considerable damage to a young peach orchard in the El Cajon Valley, San Diego County. Many of the twigs and some of the larger branches were killed back for several inches, due to the ravages of this insect.

' ' The *Hippodamia* ladybird and the larvae of a syrphid fly were abundant and devouring vast numbers of the aphids. However, it is not often that this appears abundant enough to cause any great amount of damage.

Its life history, although not thoroughly worked out, is interesting. The following brief summary is from Essig:[17]

> The insect winters over on the roots of the peach trees, where it may also be found in the summer. The first aphids appear above ground very early in the

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[17] Essig, E. O., Beneficial and injurious insects of California; ed. 2. Suppl. Mon. Bull. Cal. Comm. Hort., vol. 4, pp. 91–92, 1915.

spring and begin attacking the tender leaflets, shoots and suckers, usually those at the base of the tree or nearest the ground. These first plant lice are all wingless. As soon as the buds, young fruit, and leaves appear they are promptly attacked, the entire crop often being entirely ruined. The leaves are curled and weakened, while the young fruit is so distorted as to be killed or rendered unfit for market. During the months of April and May winged migratory females appear, which start colonies on other trees. The work continues until about the middle of July, when most of the lice leave the tops and again go to the roots.

139. **Aphis pomi** De Geer

Figures 225 to 227

De Geer, Memoires, vol. 3, p. 173, 1773 (orig. desc.).
Davidson, Jour. Econ. Ent., vol. 2, p. 301, 1909 (list).
Davidson, Jour. Econ. Ent., vol. 3, p. 377, 1911 (list). *Aphis mali* Fabr.
Weatherby, Mon. Bull. Cal. Comm. Hort., vol. 1, p. 318, 1912 (list).
Carnes, Mon. Bull. Cal. Comm. Hort., vol. 1, p. 399, 1912 (list).
Branigan, Mon. Bull. Cal. Comm. Hort., vol. 4, p. 285, 1915 (list).
Hurdley, Mon. Bull. Cal. Comm. Hort., vol. 4, p. 445, 1915 (list).
Baker and Turner, Jour. Agr. Res., vol. 5, pp. 955–995, 1916 (complete account).

Records.—Pyrus malus; Crataegus oxycantha; Catalpa sp.; California.

In California this species has been reported on apple and hawthorn (*Crataegus* sp.) at Stanford University by Davidson and Morrison; in Humboldt County by Weatherby; at Santa Rosa by Carnes; and by others in Orange, Placer, Sonoma, Santa Cruz, San Bernardino, and Monterey counties. Horticultural Commissioner Armitage states that it has never been found in San Diego County, and Horticultural Commissioner Norton writes that it is unknown in Nevada County. These are the only two of the apple growing regions of the state in which it is not known. The author has found it at Stanford University on apple, catalpa, pear, and hawthorn, and at Marysville on catalpa. Gillette lists loquat, quince, and flowering crab as additional hosts. It seems to prefer the apple to other hosts, and it is on the apple that its greatest injury is done. Gillette states: "Among the apple trees it has its preference. Missouri Pippin seems to be its first choice, while Rome Beauty, Black Twig, Ben Davis, and a few others are second choice, and the Northern Spy is scarcely attacked." The fact that the Northern Spy is almost immune is interesting in that this variety is also quite immune to the devastations of the woolly aphis (*Eriosoma lanigera* Hausman).

The life history of this aphid is quite similar to that of many other species, and is as follows:

The eggs are laid in the fall of the year, probably during the latter part of October, throughout November, and on into December. They are laid for the most part on the smooth bark of the suckers and water sprouts of the newer shoots. The author has found them in the crotches of the twigs and stems where the bark is rougher, but this is not the usual place. These eggs hatch in the spring about the time the buds begin to show green. In California this is usually during March, although some seasons it is as early as the middle of February, depending entirely upon the weather conditions. These stem-mothers at first feed on the young buds, until the latter have opened enough to allow the aphids to crawl down into the curled leaves. Here they feed for two or three weeks, when they mature and begin depositing living young. This second generation consists chiefly of apterous females, which mature in from two to four weeks and in turn produce young. The following generations are in large part alate females which migrate to other trees and there form new colonies. The alates are most common at Stanford University during the latter part of May and during the month of June. After June they seem to lessen in number, perhaps due to the predaceous and parasitic enemies. The first alates that the author has found in the spring were taken at Stanford University on April 13, 1914. In the fall, often as early as October, sexual males and females begin to appear, the males being apterous, the females alate. These mate and very soon the female lays its eggs. Egg laying begins usually in the latter part of October, just as the leaves are beginning to fall, and continues into December after the trees are bare. These eggs hatch in the spring into stem mothers, and the life cycle is completed.

140. **Aphis prunorum** Dobr

Figures 228 to 230

Dobrowljansky, Zur Biol. d. Blattläuse d. Abstbaume u. Burenstaucher, 1913 (orig. desc.).

Patch, Maine Agr. Exp. Sta., Bull. 233, p. 262, 1914 (desc. note).

Records.—Prunus domestica; Walnut Creek (Davidson); San Francisco, April, 1915 (Shinji).

A species of *Aphis,* supposed to be this species, has been taken on prune and plum in the San Francisco Bay region. It agrees very well with Dr. Patch's description listed. However, it may prove to be synonymous with *Siphocoryne nymphaeae* (Linn.).

141. **Aphis pseudobrassicae** Davis

Figure 231

Davis, Can. Ent., vol. 46, p. 231, 1914 (orig. desc.).

Records.—Brassica spp.; Walnut Creek (Davidson), San Diego, Riverside: *Raphanus* sp., Riverside, September, 1916, June, 1917: *Matthiola annua*, Riverside, February to May, 1917.

Oftentimes in the spring this false cabbage aphis is found in large colonies on radish, mustard, and so forth. Davidson has taken it in the San Francisco Bay region, and the author throughout southern California. The first few times that it was observed by the author colonies of *Aphis brassicae* Linn. were also abundant. This led the author to doubt its validity, and to undertake some breeding experiments. In February, 1917, two colonies were started, each from one alate female. They were followed through three generations, with the result that all the individuals proved to be this species. At the same time a colony of *Aphis brassicae* Linn. was started from one alate. All the progeny of this individual proved to be the same. *A. pseudobrassicae* Davis differs from *A. brassicae* Linn. in the following major points:

A. pseudobrassicae Davis:	*A. brassicae* Linn.:
Apterae not pulverulent.	Apterae pulverulent.
Cornicles of apterae longer than hind tarsi.	Cornicles of apterae shorter than hind tarsi.
IV of alates with sensoria.	IV of alates without sensoria.

142. **Aphis ramona** Swain

Figures 232 to 235

Swain, Trans. Am. Ent. Soc., vol. 44, p. 14, 1918 (orig. desc.).

Records.—Ramona stachyoides; Nordhoff and Santa Paula, Ventura County (Swain).

This species has been taken twice in Ventura County by Essig. It was described by the author from the specimens taken by Essig on black sage.

143. **Aphis rubiphila** Patch

Patch, Maine Agr. Exp. Sta., Bull. 233, p. 269, 1914 (orig. desc.).

Records.—Rubus spp.; San Jose, May, 1916 (Davidson).

In the summer of 1916 Davidson found a species of *Aphis* infesting loganberries and blackberries in San Jose, which was determined by Dr. Patch as *A. rubiphila* Patch. Essig believes this to be a synonym of *A. gossypii* Glover, but as the author has not had an opportunity to study specimens he believes it best to recognize it as a distinct species at present.

144. **Aphis salicicola** Thomas

Figures 188, 238, 237

Thomas, Ill. Lab. Nat. Hist., Bull. 2, p. 8, 1879 (orig. desc.).
Williams, Univ. Neb. Studies, vol. 10, p. 139, 1910 (desc.).
Davidson, Jour. Econ. Ent., vol. 5, p. 408, 1912 (list).

Records.—*Salix laevigata;* Berkeley, June, 1915: *Salix,* sp.; San Jose (Davidson).

This is an uncommon species, found in the San Francisco Bay region on willow. The individuals are found in large colonies on the terminal shoots and leaves. These colonies consist in large part of apterae, there being but a very few alates. The species is quite easily recognized by the long cornicles and by the very short second branch of the third discoidal vein.

145. **Aphis sambucifoliae** Fitch

Figure 240

Fitch, Cat. Homop. N. Y., p. 66, 185 (orig. desc.).
Sanborn, Kan. Univ. Sci. Bull. 3, p. 52, 1904 (desc.).

Records.—*Sambucus glauca;* Oakland, April, 1915 (Essig); Berkeley, July, 1915.

In 1915 this species was taken twice, once by Essig in Oakland and once by the author in Berkeley. This medium-sized black aphid occurs in large colonies on the tender shoots and flower heads of the common elderberry. In southern California the author has examined hundreds of elderberry trees for this form, but has never found it. Only once has he found any aphid on elderberry in the south, and these proved to be *Rhopalosiphum persicae* (Sulz.).

146. **Aphis senecio** Swain

Figures 2, 4, 6, 241 to 245

Davidson, Jour. Econ. Ent., vol. 2, p. 302, 1909. *Aphis* sp. (list).
Davidson, Jour. Econ. Ent., vol. 3, p. 377, 1910. *A. bakeri* Cowen (list).
Davidson, Jour. Econ. Ent., vol. 7, p. 133, 1914. *A. bakeri* Cowen (list).
Swain, Trans. Am. Ent. Soc., vol. 44, p. 16, 1918.

Records.—*Abutilon* sp.; Stanford University, February, 1915: *Ambrosia psilostachya;* Berkeley, 1915 (Essig): *Amsinckia* spp.; Stanford University, 1909 (Davidson), 1912 (Morrison); Berkeley, 1915 (Essig): *Anthemis* spp.; San

Francisco Bay region, 1914 (Davidson); Pasadena, May, 1917 (Roy E. Campbell): *Artemisia* spp.; San Francisco Bay region, 1914 (Davidson); Berkeley, 1915 (Essig): *Aster* sp.; San Diego, January, 1916; Ontario, January, 1917: *Baccharis pilularis;* Berkeley, 1915 (Essig), Stanford University, 1916 (Ferris): *Calendula officinale;* Berkeley, 1915 (Essig); San Diego, March, 1916; Riverside and Orange, February, 1917: *Chrysanthemum* sp.; Berkeley, 1914 (Essig); October, 1915; Menlo Park, San Mateo County, March, 1915; San Diego, January, 1916; La Jolla, February, 1916; Ontario, January, 1917: *Cytisus proliferus;* Berkeley, 1915 (Essig): *Gnapholium* sp.; Walnut Creek, 1914 (Davidson): *Grindelia cuneifolia;* Walnut Creek, 1915 (Davidson): *Helianthus annuus;* San Francisco Bay region, 1914 (Davidson): *Rumex* sp.; Stanford University, March, 1915: *Salix* sp.; Berkeley, 1915 (Essig): *Senecio* spp.; Stanford University, 1909, 1910, 1914 (Davidson); Santa Paula, 1911 (Essig); Palo Alto, February, 1915.

This is a very common species throughout California, occurring on many host plants, particularly the Compositae. It is found most commonly in the early spring on asters, marigolds, and chrysanthemums in southern California, and on German ivy and amsinckia in the San Francisco Bay region. For sometime it was believed to be *Aphis bakeri* Cowen, but its variety of host plants so widely different from those of *bakeri*, led to its being identified as a distinct species. It is one of the most common in the state, as a glance at the collection records will show.

147. **Aphis setariae** Thomas

Figures 246, 247

Thomas, Ill. Lab. Nat. Hist., Bull. 2, p. 5, 1878 (orig. desc.).
Williams, Univ. Neb. Studies, vol. 10, p. 141, 1910 (desc.).

Record.—Prunus domestica; San Francisco Bay region (Davidson).

In some parts of the country this plum louse becomes abundant enough to cause serious damage, but it has never been observed to be so in California. Davidson writes that he has found it sparingly a few times in the San Francisco Bay region. The author has never collected it, but has had access to specimens from Morrison, taken in Indiana.

148. **Aphis spiraecola** Patch

Patch, Maine Agr. Exp. Sta., Bull. 233, p. 270, 1914 (orig. desc.).

Records.—Spiraea spp.; Stanford University, 1912 (Morrison); Walnut Creek, Contra Costa County, 1916 (Davidson).

In the San Francisco Bay region there is a small aphid very similar to *Aphis pomi* De Greer found attacking meadowsweet. Davidson and Morrison, who have both observed it, believe it to be this species. The following brief descriptive notes are from alate females taken by Dr. Patch on cultivated spiraea in Orono, Maine. These notes are included here as there is no adequate description of this species, the only ones[18] being very meager notes indeed .

Alate viviparous females.—Body rather long and narrow, head normal with no antennal tubercles. Antennae shorter than body, reaching to about the base of the fourth abdominal segment. VI spur the longest segment, followed by III, which is about two-thirds as long. Following III are IV, V, and VI base. The usual primary sensoria are present on V and VI, and the accessory sensoria on VI. The secondary sensoria are fairly large and circular. There are six or seven in an even line along the whole length of III. On IV there may be one or two near the middle, or there may be none. Prominent lateral tubercles are present on the prothorax and on the first and seventh abdominal segments. The cornicles are fairly long, slender, and taper slightly toward the apex. They are from one and one-half to two times as long as the hind tarsi, and subequal to or very slightly longer than the cauda. The cauda is fairly long, ensiform, slightly constricted before the tip. The wings are normal, with the second branch of the third discoidal nearer the apex of the wing than the base of the first branch.

Measurements: Body length, 1.19 to 1.33 mm.; width of thorax, 0.544 to 0.561 mm.; antennae total, 0.85 to 0.918 mm.; III, 0.17 to 0.1785 mm.; IV, 0.136 to 0.153 mm.; V, 0.1275 to 0.1445 mm.; VI, base 0.0935 to 0.102 mm.; VI, spur 0.238 to 0.255 mm.; cornicles, 0.1785 to 0.187 mm.; cauda, 0.17 mm.; hind tarsus, 0.102 mm.; wing length, 1.97 to 2.04 mm.; width, 0.748 to 0.782 mm.; expansion, 4.55 mm.; from base of first branch of third discoidal to wing tip, 0.578 to 0.68 mm.; from base of second branch to wing top, 0.17 to 0.255 mm.

149. **Aphis tetrapteralis** Cockerell

Cockerell, South. Cal. Acad. Sci., Bull. 1, p. 4, 1902 (orig. desc.).

Record.—*Atriplex canescens tetraptera;* La Jolla (Cockerell).

This species has been observed but once, when described by Cockerell. He writes: "It differs from *Aphis atriplices* Linn. by its smaller size, mode of life, and shorter cornicles. It seems to be related to *Aphis monardae* Oestlund." In 1916 the author spent considerable time hunting for this species in the vicinity of La Jolla, but in vain.

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[18] Patch, Edith M., Maine Aphids of the Rose Family, Maine Agr. Exp. Sta., Bull. 233, p. 270, 1914, *Aphis spiraecola* n.n.; Gillette, C. P., Plant louse notes, Family Aphididae. Jour. Econ. Ent., vol. 3, p. 404, 1910. *Aphis spiraecella* Schout.

150. **Aphis viburnicolens** n.sp.

Records.—*Viburnum tinus;* Riverside, February to May, 1917; Redlands, February, 1917; Orange, February, 1917: *Laurus rotoundifolia,* Riverside, March, 1917.

In the early spring there is a small green and black aphid that attacks in great numbers the racemes of laurustinus and laurel in Southern California. In fact, it is so abundant at times as to seriously injure the plants by preventing them from flowering. The leaves and buds are very sticky and covered with the sooty mold fungus. During April, 1917, all the aphids left the laurel and laurustinus, but the alternate host has as yet not been observed. Specimens were sent to Gillette and Patch for determination, but neither could identify them. Dr. Patch wrote as follows:

> This insect is not *spiraecola,* a slide of which I am sending you.

spiraecola	sp.
Cornicles longer than III	Cornicles shorter than III
VI spur longer than III	VI spur subequal to III
VI spur longer than IV and V	VI spur subequal to IV and V
IV subequal to V	IV longer than V

> I do not know this species. I do not have *spiracella* Schout. for comparison.

Gillette stated concerning this species: "This is a species of *Aphis* close to, but almost certainly distinct from, *spiracella* Schout., and so far as we know, may be new."

From this it would appear that the species from laurustinus and laurel is a new species, and it is described herewith as such.[19] Cotype specimens are in the author's private collection, in the collection of the University of California in Berkeley, and of the Citrus Experiment Station in Riverside.

Alate viviparous female.—Prevailing color green. Head and thorax dusky brown to black. Antennae dusky to black. Beak light brown with tip black. Tibiae, femora of fore legs, and basal one-half of femora of middle and hind legs brown; tarsi, tips of tibiae, tips of fore femora, and apical one-half of middle and hind femora black. Abdomen pale to apple green, sometimes with a few dusky marginal spots. Cornicles and cauda black.

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[19] The species reported by Davidson (Jour. Econ. Ent., vol. 3, p. 377, 1910) as *Aphis mali* Fabr. from *Laurus laurustinus* (*Viburnum tinus?*) and by Essig (Injurious and Beneficial Insects of California, Mon. Bull. Cal. Comm. Hort., Supp. vol. 4, p. xlvi, 1915) as *Aphis pomi* De Geer from laurustinus, are probably this species.

Head normal, with frontal and antennal tubercles absent. Antennae short, reaching only to the second abdominal segment. III and VI spur subequal; IV and V subequal and about three-fourths as long as III or VI spur. The usual primary sensoria are present on V and VI, and the accessory sensoria on VI. Secondary sensoria are found on III and IV, from five to nine on the former and from one to four on the latter. Cornicles short, subcylindrical, and tapering from base toward apex. Cauda fairly long, ensiform, with a slight constriction in the middle. the cauda is slightly longer than the hind tarsi, and the cornicles a little longer than the cauda. Lateral tubercles are present on the prothorax, and on the first, fourth, and seventh abdominal segments. The cornicles are subequal to IV or V. The hind tarsi are somewhat longer than VI base. The wings are fairly large, with regular venation, the second joint of the third discoidal arising about half way between the tip of the wing and the base of the first joint.

Measurements: Body length, 1.214 to 1.479 mm. (av. 1.372 mm.); width of thorax, 0.476 to 0.578 mm. (av. 0.5338 mm.); antennae total, 0.733 to 0.918 mm. (av. 0.8925 mm.); III, 0.187 to 0.230 mm. (av. 0.2067 mm.); IV, 0.136 to 0.161 mm. (av. 0.1473 mm.); V, 0.119 to 0.153 mm. (av. 0.1416 mm.); VI, base 0.085 to 0.102 mm. (av. 0.0877 mm.); VI, spur 0.204 to 0.230 mm. (av. 0.216 mm.); cornicles, 0.127 to 0.153 mm. (av. 0.1422 mm.); cauda, 0.110 to 0.136 mm. (av. 0.1252 mm.); hind tarsi, 0.102 to 0.119 mm. (av. 0.1023 mm.); wing length, 1.921 to 2.397 mm. (av. 2.167 mm.); width, 0.799 to 0.935 mm. (av. 0.8704 mm.); expansion, 4.42 to 5.304 mm. (av. 4.875 mm.).

Apterous viviparous female.—General color green with the following dusky to black: head, antennae, apex of beak, cornicles, cauda, distal margin anal plate, tarsi, and tips of tibiae. Legs, except tarsi and tips of tibiae, dusky brownish green. Antennae reach to the base of the second abdominal segment. The various segments are proportionally the same as in the alates. The beak reaches to the distal margin of the first coxae or almost to the apical margin of the third coxae. Lateral body tubercles are present on the prothorax and first, second, and seventh abdominal segments. Sometimes they are also present on the third, fourth, or fifth abdominal segments as well. The cornicles and cauda are subequal, each slightly longer than the hind tarsi, and of the same form as in the alates.

Measurements: Body length, 1.326 to 1.462 mm. (av. 1.3685 mm.); width of thorax, 0.595 to 0.68 mm. (av. 0.6975 mm.); antennae total

0.731 to 0.782 mm. (av. 0.748 mm.); III, 0.153 to 0.187 mm. (av. 0.170 mm.); IV, 0.119 to 0.136 mm. (av. 0.1224 mm.); V, 0.119 mm.; VI, base 0.085 mm.; VI, spur 0.136 to 0.1995 mm. (av. 0.1632 mm.); cornicles, 0.153 to 0.1995 mm. (av. 0.170 mm.); cauda, 0.136 to 0.170 mm. (av. 0.162 mm.); hind tarsi, 0.102 to 0.119 mm. (av. 0.114 mm.).

151. **Aphis yuccae** Cowen

Figures 303 to 305

Cowen, Colo. Agr. Exp. Sta., Bull. 31, p. 122, 1895 (orig. desc.).
Williams, Univ. Neb. Studies, vol. 10, p. 145, 1910. *Aphis yuccicola* n.sp. (desc.).

Records.—Yucca mohavensis; Moorpark, Ventura County, April, 1916 (F. M. Trimble); San Diego, May, 1916.

In April, 1916, Horticultural Inspector F. M. Trimble of Ventura County sent the author a few specimens of the alate and apterous viviparous females of this species, taken on Spanish dagger in Moorpark. In the latter part of the next month the author found a few apterae on the leaves of Spanish dagger in Golden Hill Park, San Diego. There were only a few individuals present at that time, but there was evidence of an earlier heavy infestation. Following are a few notes to supplement Williams' excellent description of this species.

III is the longest segment of the antennae, followed by VI spur, which is about three-fourths as long. IV is next, being a little over one-half as long as III and about five-sixths as long as VI spur. V is slightly shorter than IV and is followed closely by VI base, which is about one-half the length of the spur. The usual primary sensoria are present on V and VI and the accessory sensoria on VI (fig. 303). The apterae have no secondary sensoria, while the alates along the whole length of III (fig. 304) have about twenty-five irregularly placed sensoria of irregular size. VI is without sensoria. Lateral tubercles are present on the prothorax and on the first and seventh abdominal segments. The cornicles (fig. 305) are long and slightly tapering, being but slightly shorter than the spur of the sixth antennal segment and about twice as long as the hind tarsi. The cauda (fig. 305) is ensiform or sickle-shaped and about three-fourths as long as the cornicles. In length it is about equal to the fifth antennal segment and one-half again as long as the hind tarsi.

Alate viviparous females.—Measurments: Body length, 1.78 to 1.9 mm. (av. 1.86 mm.); width, (thorax), 0.95 mm.; antennae total, 1.38 to 1.51 mm. (av. 1.449 mm.); III, 0.34 to 0.425 mm. (av. 0.391 mm.); IV, 0.238 to 0.273 mm. (av. 0.256 mm.); V, 0.212 to 0.229 mm. (av. 0.219 mm.); VI, 0.136 to 0.17 mm. (av. 0.155 mm.); spur, 0.255 to 0.306 mm. (av. 0.289 mm.); cornicles, 0.255 to 0.2975 mm. (av. 0.275 mm.); cauda, 0.2125 to 0.238 mm. (av. 0.225 mm.); hind tarsi, 0.153 mm.; wing length, 3.06 to 3.4 mm. (av. 3.19 mm.); wing width, 1.27 to 1.46 mm. (av. 1.338 mm.); wing expansion, 7.48 mm.

30. Genus **Toxoptera** Koch.

Koch, Die Pflanzenlause, p. 253, 1857. Type *Aphis aurantii* Fonsc.

152. **Toxoptera aurantii** (Fonsc.)

Figures 114, 163, 276

Boyer de Fonscolombe, Ann. Ent. Soc. France, vol. 10, 1841. *Aphis* (orig. desc.).
Essig, Pom. Jour. Ent., vol. 3, p. 601, 1911. *T. aurantiae* Koch (desc.).
Davis, U. S. Dept. Agr., Bur. Ent., Tech. Ser., Bull. 25, pt. 1, p. 8, 1912.

Records.—*Citrus* spp.; throughout citrus sections of southern and central California (Essig, author); San Jose (Davidson).

This is the common black louse of the citrus trees, and is found at almost any time of the year on the younger and more tender leaves of various species of *Citrus*. It is more or less heavily preyed upon by the braconid fly, *Lysiphlebus testaceipes* Cresson. In fact, the author has noticed several infestations in which fully ninety-five per cent of the individuals were parasitized. Besides these the syrphid flies cause great havoc among colonies. Of these the author has reared *Allograpta obliqua* Say from a colony taken in the vicinity of El Cajon, San Diego County. Never does this species become abundant enough to seriously damage trees, due undoubtedly to the effective work of its predacious and parasitic enemies. Only in the spring are they found to any great extent, although occasionally throughout the year small infestation can be noticed.

31. Genus **Hyalopterus** Koch

Koch, Die Pflanzenläuse, p. 17, 1854. Type *Aphis arundinis* Fabricius (*A. pruni* Fabr.).

153. **Hyalopterus arundinis** (Fabr.)

Figures 181, 185, 186

Fabricius, Ent. Syst., vol. 4, p. 212, 1749. *Aphis* (orig. desc.).
Clarke, Can. Ent., vol. 35, p. 247, 1903 (list).
Davidson, Jour. Econ. Ent., vol. 2, p. 303, 1909 (list).
Davidson, Jour. Econ. Ent., vol. 3, p. 377, 1910 (list).
Essig, Mon. Bull. Cal. Comm. Hort., vol. 2, p. 569, 1913 (list).
Essig, Mon. Bull. Cal. Comm. Hort., vol. 3, p. 624, 1913. *A. prunifoliae* Fitch (list).
Weldon, Mon. Bull. Cal. Comm. Hort., vol. 2, p. 630, 1913 (list).
Weldon, Mon. Bull. Cal. Comm. Hort., vol. 3, p. 378, 1914 (list).
Patch, Maine Agr. Exp. Sta., Bull. 233, 266, 1914 (desc.).
Davidson, Mon. Bull. Cal. Comm. Hort., vol. 6, p. 64, 1917 (note).

Records.—Prunus spp., *Phalaria arundinacea, Phragmites communis, Typha latifolia;* central California.

During the spring and early summer of the year this ''mealy-plum louse'' is often very abundant on various species of *Prunus* in the central part of the state, especially in the San Francisco Bay region and the Sacramento Valley. As summer continues all the aphids desert the plum for other host plants, where they remain until fall. The summer hosts in California so far known are reed grass, canary grass, and tule, or cat-tail rush. In the Santa Clara Valley there is a feeling among the prune growers that this aphid is the cause of the splitting of the prunes, which is often quite extensive. However, this remains to be proven.

32. Genus **Liosomaphis** Walker

Walker, The Zoologist, p. 1119, 1868. Type *Aphis berberidis* Kalt.

154. **Liosomaphis berberidis** (Kalt.)

Figures 184, 251, 252

Kaltenbach, Monog. d. Pflanzenläuse, p. 85, 1843. *Aphis* (orig. desc.).
Davis, Ann. Ent. Soc. Am., vol. 1, p. 254, 1908. *Rhopalosiphum* (desc.).
Davidson, Jour. Econ. Ent., vol. 3, p. 378, 1910. *Rhopalosiphum* (list).

Records.—Berberis vulgaris; Stanford University (Davidson); February to May, 1915; Berkeley, June to August, 1915.

This species is found throughout the year on the lower sides of the leaves of barberry in the San Francisco Bay region. The apterae are often very abundant, but the alates are always quite scarce. This species is similar to species of *Rhopalosiphum*, particularly in the shape of the cornicles and cauda, but owing to the absence of antennal tubercles it falls into the tribe Aphidini instead of Macrosiphini. Hence Walker's genus *Liosomaphis* is maintained for this species.

33. Genus **Siphocoryne** Passerini

Passerini, Gli Afidi, 1860. Type *Aphis pastinacae* Linn. (*xylostei* Schrank).

There has been much diversity of opinion concerning this genus, some aphidologists considering it as *Siphocoryne* Passerini, some as *Hyadaphis* Kirkaldy, and some as a synonym of *Rhopalosiphum* Koch. This last is incorrect as this is most certainly not a Macrosiphini for the antennal tubercles are lacking. In 1904 Kirkaldy proposed the name *Hyadaphis* to replace *Siphocoryne*, but in the author's opinion this is uncalled for, so he maintains the original name, *Siphocoryne* Passerini.

There have been reported from various parts of California eight species of *Siphocoryne* as follows: *capreae* (Fabr.), *conii* (Dvdn.), *foeniculi* (Schrank), *nymphaeae* (Linn.), *pastinacae* (Linn.), *salicis* (Monell), *umbellulariae* (Dvdn.), and *xylostei* (Schrank). There are, however, really but three species; *capreae* (Fabr.), *nymphaeae* (Linn.) and *pastinacae* (Linn.). According to Gillette,[20] *S. salicis* Monell is a synonym of *S. capreae* (Fabr.), and *xylostei* (Schr.) of *pastinacae* (Linn.). Davidson[21] states that *S. conii* (Dvdn.) is a synonym of *xylostei* (Schr.), and therefore it is the same as *pastinacae* (Linn.). Morrison writes that the specimens Davidson called *S. foeniculi* (Schr.) are *capreae* (Fabr.), and those he described as *Hyadaphis umbellulariae* n.sp. are *S. pastinacae* (Linn.). These two species, *pastinacae* (Linn.) and *capreae* (Fabr.), have been greatly confused but Gillette[22] has worked out their synonymy quite satisfactorily. The following key for distinguishing them is from his paper.

Joints 4, 5, 6, and antennal spur subequal, the spur usually distinctly the longest, cornicles fully three-fourths as long as third joint of the antenna, a small tubercle on the alate form and a large one on the apterous individuals always present .... **capreae**

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[20] Gillette, C. P., Two *Rhopalosiphum* species and *Aphis pulverulens* n.sp., Jour. Econ. Ent., vol. 4, pp. 320–325, 1911.

[21] Davidson, W. M., Plant louse notes from California, Jour. Econ. Ent., vol. 7, p. 133, 1914.

[22] Gillette, C. P., Two *Rhopalosiphum* species and *Aphis pulverulens* n.sp., Jour. Econ. Ent., vol. 4, pp. 320–325, 1911.

Joint 6[23] of the antenna distinctly shorter than 5, the fourth still shorter and its spur nearly as long as joints 4, 5, and 6 combined, cornicles seldom much exceeding one-half the third joint of the antenna in length, and a supra-caudal tubercle or spine entirely absent .... pastinacae

Aphis nymphaeae Linn. has usually been considered by American aphidologists as a species of *Rhopalosiphum*, but the presence of lateral body tubercles, the short, robust body, and the absence of antennal tubercles place it in the Aphidini rather than the Macrosiphini. Therefore, it must be considered as belonging to this genus. Baker[24] has recently recognized it as belonging here.

Key to Californian Species

1. A small spine or tubercle present at the distal end of the body just above the cauda (figs. 255, 256) .... capreae (Fabr.)

— No supra-caudal tubercle or spine 2

2. General color pale green. VI spur as long as IV, V and VI base combined. Cornicles at most but slightly more than one-half the length of III. pastinacae (Linn.)

— General color dark brown, wine, or black. VI spur not as long as IV, V and VI base combined, although longer than any two together. Cornicles and III subequal.. nymphaeae (Linn.)

155. **Siphocoryne capreae** Fabr.

Fabricius, Ent. Syst., p. 211, 1794. *Aphis* (orig. desc.).
Clarke, Can. Ent., vol. 35, p. 252, 1903. *S. foeniculi* (Pass.) (list).
Davidson, Jour. Econ., vol. 2, p. 303, 1909. *S. salicis* Monell (list).
Davidson, Jour. Econ. Ent., vol. 3, p. 377, 1910. *S. foeniculi* (Pass.), (list).
Davidson, Jour. Econ. Ent., vol. 3, p. 377, 1910. *S. salicis* Monell (list).
Essig, Pom. Jour. Ent., vol. 3, p. 534, 1911. *Hyadaphis pastinacae* (Linn.) (desc.).

Records.—Foeniculum vulgare; Berkeley and Newcastle (Clarke), Stanford University (Davidson): *Carum* spp.; *Cicuta virosa;* Santa Paula, Berkeley (Essig): *Salix laevigata;* Santa Paula (Essig), Brea Canyon, Los Angeles County, April, 1917; Riverside, May, 1917: *Salix nigra;* Lakeside, San Diego County, April, 1916: *Salix* sp., Stanford University (Davidson).

This species is found more or less abundantly in the spring on the tender shoots and leaves of willows, migrating in early summer to various species of Umbelliferae. It is more common than *S. pastinacae* (Linn.), which species is also found on Umbelliferae in the summer, but which passes the fall, winter, and spring on honeysuckle.

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[23] In all the author's specimens, VI is shorter than V, which in turn is shorter than IV, while VI spur is nearly as long as the three together.

[24] Baker, A. C. and Quaintance, A. L. Aphids injurious to orchard fruits, currant, gooseberry and grape, U. S. Dept. Agr., Farmers' Bulletin 804, p. 21, 1917.

156. **Siphocoryne nymphaeae** Linn.

Figure 172

Linnaeus, Syst. Nat., vol. 2, p. 734, 1735. *Aphis* (orig. desc.).
Davidson, Jour. Econ. Ent., vol. 3, p. 377, 1910. *Rhopalosiphum* (list).
Essig, Pom. Jour. Ent., vol. 4, p. 793, 1912. *Rhopalosiphum* (desc.).
Davidson, Mon. Bull. Cal. Comm. Hort., vol. 6, p. 65, 1917. *Rhopalosiphum* (note).

Records.—Polygonum sp., *Alisma* sp., *Potamogeton* sp.; San Francisco Bay region (Davidson): *Typha latifolia;* Santa Paula (Essig), San Francisco Bay region (Davidson): *Nymphaea* sp.; San Francisco Bay region (Davidson), Fresno, June, 1915: *Prunus domestica;* Berkeley, 1916 (Essig).

This aphid occurs throughout the summer months on various semiaquatic plants, lily, tule, and so forth. In the fall it migrates to plum, where eggs are laid. The first two or three generations in the spring occur on plum, but about June there is a migration to its summer host plants. So far it has been found in southern California only in Ventura County.

The species listed as *Aphis prunorum* Dobr. (see no. 140) may be this species. Essig believes it is, but the author is not certain so does not list it as a synonym.

157. **Siphocoryne pastinacae** Linn.

Figures 266 to 270

Linnaeus, Syst. Nat., p. 451, 1735. *Aphis* (orig. desc.).
Davidson, Jour. Econ. Ent., vol. 2, p. 304, 1909. *S. xylostei* (Schr.) (list).
Davidson, Jour. Econ. Ent., vol. 2, p. 304, 1909. *S. conii* n.sp. (desc.).
Davidson, Jour. Econ. Ent., vol. 3, p. 377, 1910. *S. xylostei* (Schr.) and *S. conii* Dvdn. (list).
Davidson, Jour. Econ. Ent., vol. 4, p. 599, 1911. *Hyadaphis umbellulariae* n.sp. (desc.).
Davidson, Pom. Jour. Ent., vol. 3, p. 399, 1911. *S. conii* Dvdn. (list).
Davidson, Jour. Econ. Ent., vol. 7, p. 133, 1914. *S. xylostei* (Schr.) (list).

Records.—Lonicera sp.; Stanford University (Davidson), Claremont (Essig), Berkeley, April, 1915: *Umbellularia californica;* San Jose (Davidson): *Conium maculatum;* Stanford University, Penryn, Placer County, and San Jose (Davidson).

This aphid occurs on honeysuckle during the winter and spring, and on various semiaquatic plants in the summer. It has been taken in southern California, in the San Francisco Bay region, and in the Sacramento Valley.

34. Genus **Myzaphis** Van der Goot

Van der Goot, Zür Systematik der Aphiden, Tijdscrift voor Entomologie, vol. 56, p. 96, 1913. *Type Aphis rosarum* Walker.

The author believes that this genus of Van der Goot's should be accepted for the two following species: *Aphis abietina* Walker and *Aphis rosarum* Walker. *A. rosarum* has usually been considered as belonging to the genus *Myzus*, but the absence of antennal tubercles excludes it from that genus (see figs. 306–308, 313). The cornicles and cauda are not typical of *Aphis*, and these together with the distinctive frontal tubercle on the head and the absence of lateral body tubercles distinguish it from *Aphis*. Consequently this genus should be recognized. Following is a key for separating the two known species, both of which occur in California:

Cornicles slightly clavate (figs. 312, 315), shorter than III. III tuberculate, IV without sensoria (fig. 309). Found on *Rosa* spp. ....**rosarum** (Walker)

Cornicles cylindrical (fig. 197), equal to or longer than III. III with 9 to 12 rather large secondary sensoria, IV with 1 to 4 (fig. 196). On conifers. **abietina** (Walker)

158. **Myzaphis abietina** (Walker)

Figures 196, 197

Walker, Ann. Mag. Nat. Hist., vol. 3, p. 301, 1848. *Aphis* (orig. desc.).
Wilson, Proc. Ent. Soc. Brit. Columbia, June, 1915 (desc.).

Record.—Picea excelsa; San Francisco, March, 1915 (Compere).

The only report of this species in America is that of Wilson, who found it on spruce (*Picea* sp.) at Vancouver, British Columbia. On March 26, 1915, Harold Compere of San Francisco took a number of specimens of this species on the twigs of Norway spruce (*Picea excelsa*) in Golden Gate Park, San Francisco. The specimens are in Essig's and the author's collections.

159. **Myzaphis rosarum** (Walker)

Figures 308 to 317

Walker, Ann. Mag. Nat. Hist., vol. 3, 1848. *Aphis* (orig. desc.).
Davidson, Jour. Econ. Ent., vol. 3, p. 379, 1910. *Myzus* (list)

Records.—Rosa spp.; Stanford University (Davidson); Santa Paula (Essig), San Diego, March to July, 1916.

This species has been reported in the San Francisco Bay region by Davidson and in Santa Paula by Essig. In the Bay region it is rather scarce and is second to *Macrosiphum rosae* (Linn.) in abundance on roses. The author has taken it at Stanford University in 1915, and in San Diego several times in 1916. In San Diego in 1916 it was by far the most abundant rose-infesting aphid. The author has observed it in such numbers on roses as to cover the undersides of practically all the leaves and the calyx cups of the flowers. In some cases the buds were stunted and the flowers unshapely from its effect. In the rose garden of the Panama-California International Exposition these aphids were of considerable importance, necessitating continual care to keep them under control.

Since there is no adequate description of this species in the American aphid literature the author describes it herewith. The following description was drawn from ten specimens of alate and eight of apterae, collected in Santa Paula, Stanford University, and San Diego.

Alate viviparous female.—Color notes (taken from notes made at the time of collection of specimens at Stanford in March, 1915): Head, antennae, and thoracic plates black. Abdomen pale apple green with smoky blotch on dorsum. Legs: apical two-thirds of femora smoky, basal one-third pale, tibiae pale except dusky tip, tarsi dusky. Cornicles green (dusky), cauda pale apple green.

Head is twice as wide as long with a fairly distinct tubercle on the front (fig. 308). Antennal tubercles are lacking or very indistinct. Antennae reach almost to the base of the third abdominal segment (figs. 309, 310). III is the longest segment, followed by IV, spur, V, and VI. The spur and IV are practically equal. Of sixteen antennae examined, in three the spur and IV were equal, in ten, IV was slightly longer than the spur, while in three, the spur was slightly longer than IV. V is slightly shorter than the spur, and VI slightly shorter than V. However, IV, spur, V, and VI are all almost equal. On V and VI are the usual primary sensoria, and VI the accessory sensoria (fig. 300). III is tuberculate, being furnished with a large number of irregularly placed secondary sensoria (fig. 309). IV is without any sensoria. The beak reaches almost to the second coxae.

The prothorax is without lateral tubercles. The wings are normal, being about twice the length of the body. The second branch of the cubitus arises nearer the apex of the wing than the base of the first branch (fig. 311). In but one of seventeen specimens examined was the origin of the second branch of the cubitus nearer the base of the first branch than the tip of the wing. In this specimen the measurements were: 0.561 mm. from tip of wing to base of first branch and 0.289 mm. from tip of wing to base of second branch.

The abdomen is long and narrow and is without lateral body tubercles. The cornicles (fig. 312) are long, being but slightly shorter than the third antennal segment, and over twice as long as the hind tarsi. They are slightly clavate on the inner side. The cauda (fig.

312) is long and pointed (ensiform), being slightly more than one-half as long as the cornicles and about one-half as long again as the hind tarsi.

Measurements: Body length, 1.19 to 1.41 mm. (av. 1.28 mm.); width of thorax, 0.459 to 0.527 mm. (av. 0.487 mm.); antennae total, 0.85 to 1.156 mm. (av. 1.027 mm.); III, 0.255 to 0.34 mm. (av. 0.317 mm.); IV, 0.1275 to 0.2295 mm. (av. 0.1768 mm.); V, 0.119 to 0.17 mm. (av. 0.1365 mm.); VI, 0.085 to 0.119 mm. (av. 0.1095 mm.); spur, 0.119 to 0.204 mm. (av. 0.1695 mm.); cornicles, 0.238 to 0.306 mm. (av. 0.2574 mm.); cauda, 0.136 to 0.187 mm. (av. 0.1588 mm.); hind tarsi, 0.119 to 0.136 mm. (av. 0.1205 mm.); wing length, 2.482 to 2.72 mm. (av. 2.5483 mm.); wing width, 0.884 to 1.02 mm. (av. 0.9396 mm.); wing expansion 5.423 to 5.967 mm. (av. 5.5836 mm.). From tip of wing to base of first branch of cubitus 0.561 to 1.037 mm. (av. 0.8041 mm.); from tip of wing to base of second branch of cubitus, 0.17 to 0.34 mm. (av. 0.2907 mm.).

Apterous viviparous female.—Head about as long as broad with a large prominent tubercle on the front, this tubercle being considerably larger than in the alate form; in some individuals it is fully as large as the first antennal segment (fig. 313). Antennal tubercles small but distinct, similar to those of the alate. Antennae (fig. 314) short, reaching only to the third coxae. III is the longest segment, followed by the spur, IV, VI, and V. These are all subequal, the formula of the averages being spur, IV, VI, and V. The formulae for seven antennae are S, VI (V, IV); S, (VI, V, IV); S, V, IV, VI; S, IV (V, VI); S, (IV, V), VI; IV (V, VI, S); (S, VI, IV), V. The usual primary sensoria are present, but there are no secondary sensoria. The beak is short, reaching only to the second coxae.

The prothorax is without tubercles. The thorax is normal, as are the legs. The abdomen is long and narrow, without lateral tubercles, and without long capitate hairs as found in some species of *Myzus*. The cornicles (fig. 315) are long, cylindrical, and slightly tapering toward the apex, or slightly clavate at apex. They are over twice as long as the third antennal segment and over three times as long as the hind tarsi (fig. 317), and half as long again as the cauda. The cauda (fig. 316) is long and ensiform, being slightly more than twice the length of the hind tarsi, and about two-thirds the length of the cornicles.

Measurements: Body length, 1.275 to 1.615 mm. (av. 1.428 mm.); width of thorax, 0.493 to 0.748 mm. (av. 0.6375 mm.); antennae total, 0.544 to 0.731 mm. (av. 0.6239 mm.); III, 0.153 to 0.238 mm. (av.

0.178 mm.); IV, 0.068 to 0.119 mm. (av. 0.0855 mm.); V, 0.068 to 0.102 mm. (av. 0.0833 mm.); VI, 0.068 to 0.119 mm. (av. 0.085 mm.); spur, 0.085 to 0.136 mm. (av. 0.117 mm.); cornicles, 0.306 to 0.442 mm. (av. 0.3655 mm.); cauda, 0.204 to 0.272 mm. (av. 0.2338 mm.); hind tarsi, 0.102 mm. (Note: no color notes were taken of the apterae at the time of collection and as all the specimens were killed in alcohol, dehydrated in xylene and mounted in Canadian balsam, it is impossible to give any color notes.)

35. Genus **Coloradoa** Wilson

Wilson, Ann. Ent. Soc. Am., vol. 3, p. 323, 1910. Type *Aphis rufomaculata* Wilson.

This genus was described by Wilson in 1910 to contain the species *Aphis rufomaculata* Wilson. After examining specimens of this species recently, the author is of the opinion that *Coloradoa* and *Myzaphis* are synonymous, for there does not seem to be enough difference between this species and the two species of *Myzaphis* to warrant a separation of genera. However, the author does not feel certain concerning the point, so lists both these genera. Should they later prove to be synonymous, *Myzaphis* would have to be dropped and replaced by *Coloradoa*. There is but one species belonging to this genus.

160. **Coloradoa rufomaculata** Wilson

Wilson, Ent. News, vol. 14, p. 261, 1908. *Aphis* (orig. desc.).

Record.—Chrysanthemum, cultivated; Sacramento, April, 1917 (Davidson).

The author has recently received specimens of this species from Davidson taken on chrysanthemum in Sacramento.

36. Genus **Cerosipha** Del Guercio

Del Guercio, Nouve relazione agraria di Firenze, vol. 2, p. 116, 1909. Type *C. passeriniana* n.sp.

161. **Cerosipha cupressi** Swain

Swain, Trans. Am. Ent. Soc., vol. 44, p. 19, 1918 (orig. desc.).

Records.—*Cupressus guadelupensis;* San Diego, 1916; Riverside, 1917; *C. macrocarpa,* San Diego, 1916.

This species, recently described by the author, has been taken by him several times in San Diego and Riverside on blue cypress and Monterey cypress. It is an extremely interesting little aphid, differing considerably from any other species known to the author, both in habits and appearance. Its five-jointed antennae, long cauda, atrophied cornicles, and convexity of abdomen are quite distinctive.

Subfamily **Pemphiginae** Mordwilko[25]

Mordwilko, Ann. Mus. Zool. Imp. Acad. Sci. St. Petersburg, vol. 13, pp. 362–364, 1908.

A summary of Mordwilko's description of this subfamily has already been given. The latest and probably the most complete systematic work on this subfamily that has been done is that of Dr. Albert Tullgren of Stockholm, Sweden, in his paper, "Aphidologische Studien I" in 1909. Tullgren divides this subfamily into six tribes, viz: Vacunina, Hormaphidina, Mindarina, Pemphigina, Schizoneurina, and Anoeciina. In the tribe Vacunina he places *Vacuna* Heyden and *Glyphina* Koch; in Hormaphidina is the one genus *Hamamelistes* Shimmer; in Mindarina is the one genus *Mindarus* Koch; in Pemphigina he places *Asiphum* Koch, *Pachypappa* Koch, *Prociphilus* Koch, *Thecabius* Koch, and *Pemphigus* Hartig; in Schizoneurina he places the two genera, *Schizoneura* Hartig, and *Tetraneura* Hartig; and finally in the Anoeciina is found the one genus *Anoecia* Koch. It can be seen that he uses several of Koch's genera which have not heretofore been generally used, namely: *Prociphilus* Koch, *Thecabius* Koch, *Asiphum* Koch, and so forth. Lately there has been a tendency among American aphidologists to accept these genera, and thus to divide up the larger genus *Pemphigus* into these smaller ones. Mordwilko in his keys divides this subfamily into four groups, namely: Hormaphidina, Pemphigina, Schizoneurina, and Vacunina. In Hormaphidina he includes besides the genus *Hamamilestes* Shimmer, the genera *Hormaphis* Osten-Sacken and *Cerataphis* Lichtenstein. In Pemphigina he includes *Pentaphis* Heyden, *Tetraneura* Hartig, *Pemphigus* Hartig, *Aploneura* Passerini, *Rhizoctonus* Horvath, and *Paracletus* Heyden. In *Schizoneurina* he places *Lowia* Lichtenstein, *Colopha* Monell, *Pachypappa* Koch, *Schizoneura* Hartig, *Anoecia* Koch, and *Mindarus* Koch. In *Vacunina* he includes but the one genus *Vacuna* Heyden, which he does not separate from *Glyphina* Koch.

There is considerable difference in the classifications of these two authors, but as far as we are concerned here in California our genera are placed about the same by both. Following is a translation of Mordwilko's key to the groups:

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[25] The author has under way a more exhaustive study of this subfamily, particularly of the species of *Pemphigus* and *Prociphilus*. As this research is still in progress, however, it was thought best to omit any report of it, the author here confining himself merely to the records of the presence of the various species in California. It was hoped to have this study completed at the present time, but the unprecedented conditions of this season have made it necessary to delay further study for the time being.

1. Winged forms with a cucurbit-shaped cauda. Nymphs that failed to molt with three-jointed antennae. Winged forms with three to five-jointed antennae, which are coarsely ringed from the third on. Wingless parthenogenetic females presenting the appearance of the larvae of other families, as of some kinds of Coccidae, or of species of *Aleyrodes*. Sexual forms with beaks ....Group **Hormaphidina**

— Winged forms without distinct cauda. Nymphs that failed to molt with four to five-jointed antennae. Antennae of winged females five-to six-jointed. Sensoria may be found on the third and following joints, often in the form of arches or half rings, but never as complete rings 2

2. Cubitus [third discoidal vein] of the fore wings simple. Cornicles, which are pore or pointlike, present only in some species, and then not in all forms. Group **Pemphigina**

— Cubitus [third discoidal vein] of fore wings once-branched. Cornicles mostly point or pore-like 3

3. Antennae of winged forms six-jointed. Wings held roof-like when at rest. Group **Schizoneurina**

— Antennae of winged forms five-jointed. Wings held flat when at rest. Group **Vacunina**

Group **Hormaphidina** Mordw.

Mordwilko, Ann. Mus. Zool. Imp. Acad. Sci. St. Petersburg, vol. 13, pp. 364-365, 1908.

The antennae of the winged forms are 5- to 3-jointed (?). With the exception of the first two joints they are closely and entirely ringed. Even in the genus *Hormaphis* O.-S., where the antennae are 3-jointed, they may probably be considered morphologically as of five joints. The wings are held flat at rest. There are four transverse veins on the fore wings, the third of which [third discoidal] is simple. The first two [first and second discoidals] originate at the same point on the subcosta. The hind wings have one or two transverse veins, in the latter case both originating at the same point. The wingless parthenogenetic females on the alternate host plants (for example on birch) are mostly circular in shape, and have small wax tubes around them. Other forms are coccid-like. The sexual forms have beaks. The cornicles are absent.

This is a description as given by Mordwilko in the above mentioned paper. Below is a key to the genera, as given by Mordwilko and by Van der Goot, the latter of whom includes in this group the two genera *Hamamelestes* Shimmer and *Cerataphis* Licht.

1. Antennae of winged females plainly five-jointed 2

— Antennae of winged females only three-jointed ....**Hormaphis** O.-S.

2. Antennae always five-jointed. Front of head always with two little horns. Third discoidal once-branched ....**Cerataphis** Lichtenstein

— Antennae of apterous forms three- or four-jointed. Front without horns. Third discoidal simple ....**Hamamelistes** Shim.

37. Genus **Cerataphis** Lichtenstein

Lichtenstein, Bull. Société ent. de France, vol. 2, p. 16, 1882. Type *Coccus lataniae* Boisd.

162. **Cerataphis lataniae** Boisduval

Boisduval, Ent. Hort., 1867. *Coccus* (orig. desc.).
Davidson, Jour. Econ. Ent., vol. 5, p. 404, 1912 (list).
Essig, Univ. Calif. Publ. Entom., vol. 1, p. 342, 1917 (list).

Records.—Fern, Stanford University (Davidson); orchid, Oakland (Essig).

This coccid-like species has been reported twice in the San Francisco Bay region, by Davidson and by Essig. Morrison and the author have also taken it on the same ferns on which Davidson found it in the Stanford University nursery.

Group **Pemphigina** Lichtenstein

Below is a key to the California genera of this group, adapted from Mordwilko, Tullgren and Del Guercio. Del Guercio described a genus in 1909 for *Pemphigus radicicola* Essig, which he called *Trifidaphis*.

1. Antennae of alate females five-jointed ....**Trifidaphis** Del Guer
— Antennae of alate females six-jointed 2
2. Stem mothers with five-jointed antennae. Wax-gland plates on head always present and usually large. Spring and fall migrants with wax-gland plates always on mesothorax and abdomen, and usually on head. Dorsal pores never present 3
— Stem mothers with four-jointed antennae. Head normally without wax-gland plates. Dorsal pores sometimes present. Stem mothers and spring migrants (fundatrix and fundatrigenia) at first live in the same closed galls. **Pemphigus** Hartig
3. Secondary sensoria furnished with hairy fringe (Wimperkranz). Wax-gland plates generally large. In stem mothers there appear four very large pronotal wax-gland plates, placed in a transverse row. All plates have a clearly chitinized border. Stem mother and migrants live together. **Prociphilus** Koch
— Secondary sensoria without hairy fringe (Wimperkranz). Wax-gland plates generally small. In stem mothers there are six pronotal plates, of which the four middle ones are arranged in the form of a trapezium. In the winged fall migrants (sexupara) there are also transverse abdominal gland plates, which are without clearly chitinized borders. Stem mothers and spring migrants live in separate galls ....**Thecabius** Koch

38. Genus **Trifidaphis** Del Guercio

Del Guercio, Riv. di patal. veg., vol. 3, p. 20, 1909. Type *Pemphigus radicicola* Essig.

163. **Trifidaphis radicicola** Essig

Essig, Pom. Jour. Ent., vol. 1, p. 8, 1909. *Pemphigus* (orig. desc.).
Baker, Pom. Jour. Ent., vol. 1, p. 74, 1909. (Translation of Del Guercio's description of the genus.)
Essig, Pom. Jour. Ent., vol. 2, p. 283, 1910 (list).
Essig, Pom. Jour. Ent., vol. 4, p. 699, 1912 (list).

Records.—Amaranthus retroflexus, Solanum douglasii; Claremont, Santa Paula (Essig).

Essig described this species from specimens taken on the roots of *Amaranthus retroflexus* and *Solanum douglasii* in Santa Paula and Claremont. Later Del Guercio described a new genus for this species based on the venation and the antennae. It seems that the type specimen of this species had but five-jointed antennae and so of course it could not belong to the genus *Pemphigus.* On an examination of eight specimens, including the type specimen and seven cotypes, the author finds that the number of joints in the antennae are variable. The type specimens had both antennae with but five joints. Six antennae had but five joints, six had six distinct joints, and four had five joints in which the division into six could be made out. This divison was in the third joint at about one-third the distance from the apex. Consequently one could say that this species was typically five-jointed, but with some specimens with the third joint divided into two, or it could be said that it was typically six-jointed, but in some specimens a reducton occurred through the joining of the third and fourth segments. As but a few specimens were examined the author is not willing to state which is the more common, hence leaves this as a valid genus, although he is of the opinion that this really belongs to the genus *Prociphilus* Koch.

39. Genus **Pemphigus** Hartig

Hartig, Jahresb. u. d. Fortschr. d. Forstwiss. u. forstliche Naturk., vol. 1, p. 645, 1837. Type *Aphis bursarius* Linn.

This genus is represented in California by three well known species,[26] *P. betae* Doane, *P. populi-caulis* Fitch, and *P. populi-trans-*

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[26] There has been taken several times a species forming elongate leaf galls on *Populus fremontii,* both in the San Francisco Bay region by Davidson and in San Diego County by the author, that structurally seems to be identical with *P. populicaulis* Fitch, but its gall is quite distinct, being more or less similar to that of *P. betae* Doane. Further study may reveal the identity of this form.

versus Riley. All of these species, during at least a part of their life cycles, infest various species of *Populus*, where they form more or less distinctive galls.

KEY TO FUNDATRIGENIAE[27]

1. Secondary sensoria present only on III. Galls formed on leaf petioles, with a transverse opening on the outside of the curve ......**populi-transversus** Riley
— Secondary sensoria on other segments as well as on III 2
2. Secondary sensoria on III to VI inclusive. Galls formed by the twisting of the petiole with an oblique opening on the inside of the curve. **populi-caulis** Fitch
— Secondary sensoria on III and IV.[28] Gall formed on the under side of the leaves, being more or less elongate and opening on the upper side. **betae** Doane

164. **Pemphigus betae** Doane

Doane, Ent. News., vol. 11, p. 390, 1900 (orig. desc.).
Clarke, Can. Ent., vol. 35, p. 248, 1903 (list).
Davidson, Jour. Econ. Ent., vol. 2, p. 299, 1909 (list).
Davidson, Jour. Econ. Ent., vol. 3, p. 372, 1910 (list).
Williams, Univ. Neb. Studies, vol. 10, p. 92, 1910. *P. balsamiferae* n.sp. (desc. fundatrigenia).
Essig, Pom. Jour. Ent., vol. 4, p. 299, 1912 (list).
Maxson, Jour. Econ. Ent., vol. 9, p. 500, 1916 (note).

Records.—*Beta vulgaris;* San Francisco Bay region, Monterey County, Sacramento Valley. (*Rumex* spp., *Chenopodium* spp., etc.?)

Under the name *P. betae* Doane, Clarke, Davidson, and Essig have reported a species of aphid infesting the roots of sugar beets, dock, *Chenopodium*, and other plants throughout California.

Originally this species was described from specimens taken on sugar beet in Washington, but later[29] it was proven that a species forming elongated leaf galls on *Populus balsamifera* in the spring migrated to beets, and was identical with this species. In 1916 Maxson (cited above) states that his investigations point to the fact that in Colorado there are more than one species of *Pemphigus* attacking the sugar beet, one of which is this species that forms the elongate leaf gall on poplar in the spring, and which is known now as *P. betae* Doane.

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[27] At present only a key to the alate migrants or fundatrigeniae occurring in galls on poplar is given. It is hoped that later, keys to all forms may be formulated. At present, however, the life histories of the species are not sufficiently known.

[28] The sexupara or alate migrants from beets to poplars have secondary sensoria on III to V inclusive. These form no galls on poplar, however.

[29] Parker, The life history of the sugar-beet root louse, Jour. Econ. Ent., vol. 7, pp. 136–141, 1914;
Gillette, Notes on some Colorado aphids having alternate host plants, Jour. Econ. Ent., vol. 8, p. 97, 1915.

These observations of Maxson's together with those made by the author lead to the conclusion that all the reported cases of infestation of beets and other hosts by *P. betae* Doane in California do not necessarily refer to this species. Never have the fundatrix or fundatrigenia been taken on poplar in California. This strengthens the point that the aphids on beets and other hosts may not all be *P. betae* Doane. Further studies and observations will have to be made before this point can be settled, however.

165. **Pemphigus populicaulis** Fitch

Fitch, Rep. Ins. N. Y., vol. 5, p. 845, 1859 (orig. desc.).
Clarke, Can. Ent., vol. 35, p. 248, 1903 (list).
Davidson, Jour Econ. Ent., vol. 2, p. 299, 1909 (list).
Davidson, Jour. Econ. Ent., vol. 3, p. 372, 1910 (list).
Davidson, Jour. Econ. Ent., vol. 3, p. 372, 1910. *P. populi transversus* Riley (list).
Davidson, Pom. Jour. Ent., vol. 3, p. 398, 1911. *P. populi transversus* Riley (list).
Essig, Pom. Jour. Ent., vol. 4, p. 699, 1912 (list).
Essig, Pom. Jour. Ent., vol. 4, p. 708, 1912 (desc.).
Davidson, Jour. Econ. Ent., vol. 8, p. 420, 1915 (sexuales).

Records.—Populus fremontii, P. trichocarpa; from Placer County to San Diego County (Clarke, Davidson, Essig, Morrison, and the author).

The species infests cottonwoods throughout the state, forming a gall by the twisting of the leaf petiole. The sexuales are found, according to Davidson, under the bark where the eggs are also laid. The author has found the species in San Diego County, having taken the fundatrix, virgogenia, and fundatrigenia in galls in May, 1916, and the dead sexupara at the same time in old galls. These latter probably died without ever leaving the galls.

166. **Pemphigus populi-transversus** Riley

Riley, U. S. Geog. Geol. Surv., Bull. 5, p. 15, 1880 (orig. desc.).
Essig, Univ. Calif. Publ. Entom., vol. 1, p. 343, 1917 (list).

Records.—Populus fremontii, Berkeley, September, 1914 (Essig), Riverside September to October, 1916, May to July, 1917.

This species forms large galls on the leaf petioles of poplar somewhat similar to the preceding species, differing in that the opening is on the opposite side of the gall, and is transverse rather than oblique. Essig's specimens were determined by Gillette, the author's by Maxson. Davidson reported a species under this name from Stanford

University, but later wrote the author that he was mistaken in his determination, the species being *P. populicaulis* Fitch instead.

Just recently the author received specimens of the sexupara of this species from J. R. Parker, Bozeman, Montana. These were taken by S. H. Jones in Port Allen, Louisiana, in September, 1915, on the roots of cabbages. Jones notes that cabbage and other cruciferous plants are the alternate host of this species. This spring the author received a large number of apterae of a species of *Pemphigus* taken in Orange County on the roots of cabbage. A specific determination of the species was impossible but it may have been this one.

40. Genus **Thecabius** Koch

Koch, Die Pflanzenläuse, p. 294, 1857. Type *Pemphigus affinis* Kalt.

This genus is very similar to *Prociphilus,* and by some authors, particularly Baker,[30] is considered as synonymous. However, for present purposes the author proposes to retain it for the three species included herewith.

KEY TO CALIFORNIAN SPECIES

1. Antennae short, barely reaching to the metathorax, and not one-third as long as the body. III but slightly longer than VI ....**populi-monilis** Riley
— Antennae longer, reaching beyond the base of the abdomen, and about one-half as long as the body. III considerably longer than VI 2
2. V and VI with secondary sensoria ....**populi-conduplifolius** Cowen
— VI without secondary sensoria ....**californicus** Davidson

167. **Thecabius californicus** (Davidson)

Davidson, Jour. Econ. Ent., vol. 3, p. 372, 1910. *Pemphigus ranunculi* n.sp. (orig. desc.).

Davidson, Jour. Econ. Ent., vol. 4, p. 414, 1911, renamed *Pemphigus californicus* Dvdn.

Essig, Pom. Jour. Ent., vol. 4, p. 699, 1912. *Pemphigus* (desc. ala. and apt. female).

Davidson, Jour. Econ. Ent., vol. 7, p. 127, 1914 (note).

Records.—Ranunculus californicus; San Francisco Bay region (Davidson, Morrison, Essig, author): *? Populus* sp.; Walnut Creek, Contra Costa County, May, 1915 (Davidson): *Fraxinus oregona;* Walnut Creek (Davidson).

This aphid is found quite abundantly on the roots and stems of the small California buttercup in the San Francisco Bay region. According to Davidson there is a migration during April from buttercup to ash. There may be a migration to poplar as well, for the author has specimens that seem to be this species taken by Davidson on poplar. Gillette[31] places this species as a synonym of *T. populiconduplifolius* Cowen, which attacks both *Ranunculus* and *Populus* in Colorado. Davidson, however, is convinced that they are distinct.

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[30] Baker, A. C., Identity of *Eriosome pyri,* Jour. Agr. Res., vol. 5, p. 1118, 1916.

168. **Thecabius populiconduplifolius** (Cowen)

Cowen, Colo. Agr. Exp. Sta., Bull. 31, p. 115, 1895. *Pemphigus* (orig. desc.).
Davidson, Jour. Econ. Ent., vol. 3, p. 374, 1910. *Pemphigus* (list).
Essig, Pom. Jour. Ent., vol. 4, p. 699, 1912. *Pemphigus* (list).
Gillette, Annals Ent. Soc. Am., vol. 7, p. 61, 1914 (desc. and life history).

Record.—Populus trichocarpa, Stanford University (Davidson).

This species was reported by Davidson on poplar at Stanford University. Since then no further records of its occurrence in the state have been made. In Colorado, Gillette finds that the common buttercup, *Ranunculus* sp., is an alternate host and so considers the preceding species as a synonym. This may be possible, but it is quite doubtful.

169. **Thecabius populimonilis** (Riley)

Riley, U. S. Geol. Surv., Bull. 5, p. 13, 1879. *Pemphigus* (orig. desc.).
Davidson, Jour. Econ. Ent., vol. 3, p. 374, 1910. *Pemphigus* (list)
Davidson, Pom. Jour. Ent., vol. 3, p. 398, 1911. *Pemphigus* (list).
Essig, Pom. Jour. Ent., vol. 4, p. 699, 1912. *Pemphigus* (list).
Gillette, Ann. Ent. Soc. Am., vol. 6, p. 485, 1913 (desc. and life history).

Records.—Populus spp.; Tulare and Placer counties (Davidson); Santa Paula (Essig), Riverside, 1916–1917.

Throughout central and southern California this species is found on various species of *Populus* where it forms more or less globular galls on the upper side of the leaves near the margins. In the vicinity of Riverside the young stem mothers began to appear in April (1917). When first observed in September, 1916, nearly all the galls were empty while a few contained alate migrants (sexupara probably). According to Gillette the eggs are laid on the trunks of *Populus,* thus the entire life cycle is passed on the one host plant. This is rather unusual for the Pemphiginae of this section.

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[31] Gillette, C. P., Some Pemphiginae attacking species of *Populus* in Colorado, Ann. Ent. Soc. Am., vol. 7, pp. 61–65, 1914.

41. Genus **Prociphilus** Koch

Koch, Die Pflanzenläuse, p. 279, 1857. Type *Aphis bumeliae* Schrank.

KEY TO CALIFORNIAN SPECIES

1. Stigma of forewings conspicuously darkened. V with a few annular secondary sensoria, VI with or without any. Dorsal thoracic wax plates small and oval .... **alnifoliae** (Williams)
— Stigma not conspicuously darkened. V and VI without annular secondary sensoria. Dorsal thoracic wax plates quite large and triangular. **venafuscus** Patch

170. **Prociphilus alnifoliae** (Williams)

Williams, Univ. Neb. Studies, vol. 10, p. 91, 1910. *Pemphigus* (orig. desc.).
Baker, Jour. Agr. Res., vol. 5, p. 1118, 1916 (note).

Records.—*Heteromeles arbutifoliae;* Sespe, Ventura County, March, 1915 (S. H. Essig); May, 1915 (C. P. Clausen).

There has been no record of this species from California heretofore, but the author has specimens taken on California holly or Christmas berry in Sespe Canyon during March and May, 1915, by S. H. Essig and C. P. Clausen.

171. **Prociphilus venafuscus** Patch

Patch, Ent News, vol. 20, p. 319, 1909. *Pemphigus* (orig. desc.).
Essig, Pom. Jour. Ent., vol. 3, p. 553, 1911. *Pemphigus fraxini-dipetalae* n.sp. (orig. desc.).
Essig, Pom. Jour. Ent., vol. 4, p. 699, 1912. *Pemphigus fraxini-dipetalae* Essig (list).
Childs, Mon. Bull. Cal. Comm. Hort., vol. 3, p. 220, 1914. *Pemphigus fraxini-dipetalae* Essig (list).
Wilson, Trans. Am. Ent. Soc., vol. 41, p. 85, 1915. *Prociphilus fraxini-dipetalae* (Essig) (note).
Davidson, Jour. Econ. Ent., vol. 8, p. 421, 1915. *Prociphilus fraxini-dipetalae* (Essig) (list).
Baker, Jour. Agr. Res., vol. 6, pp. 1118–1119, 1916 (desc. notes, synonymy).

Records.—*Fraxinus dipetala;* Santa Paula (Essig), Contra Costa and Santa Clara counties (Davidson): *F. oregona;* Oregon (Wilson); Berkeley, April, 1915: *Aesculus californicus;* Sacramento (Childs): *Pseudotsuga taxifolia;* Oregon (Wilson).

Occasionally this very large aphid is found infesting the leaves of ash in the San Francisco Bay region and in the mountains of southern California. In early summer it leaves the ash, and according to Wilson infests the roots of Douglas fir in Oregon. At one time Leroy Childs found a few specimens on buckeye in the vicinity of Sacramento, but it is probable that these were accidental there.

Group **Schizoneurina** Lichtenstein

This group as considered by Mordwilko contains the following genera: *Löwia* Licht., *Colopha* Monell, *Pachypappa* Koch, *Schizoneura* Hartig, *Anoecia* Koch, and *Mindarus* Koch. Tullgren places in his tribe Schizoneurina the two genera, *Schizoneura* Hartig, and *Tetraneura* Hartig. *Pachypappa* Koch he places in his tribe Pemphigina, and he has a separate tribe for each of the genera *Anoecia* Koch and *Mindarus* Koch, calling them respectively tribe Anoeciina and tribe Mindarina. Below is a translation of Mordwilko's key.

1. Wings laid flat on back when at rest .... **Löwia** Licht.
— Wings held roof-like when at rest 2
2. Stigma of forewings trapezoidal in shape, reaching only to the beginning of the curve around the end of the wing, never extending to the tip of the wing. Radial vein originating from the posterior exterior corner of the stigma 3
— Stigma linear, very long, reaching to the wing tip on the front side of the wing, and even following the backward curve of the exterior side of the wing to some extent. Radial vein starting almost at the beginning to the interior edge of the stigma. Sexual forms with beaks .... **Mindarus** Koch
3. Hind wings with one transverse vein .... **Colopha** Monell
— Hind wings with two transverse veins 4
4. Both transverse veins originating from the same point on the longitudinal veins .... **Pachypappa** Koch
— Transverse veins of hind wings originating separately 5
5. Bodies of apterous and alate forms with little hair, and covered at least on the dorsum of the abdomen with waxy powder. Cornicles pore-like (point-like). Sexual forms without beaks .... **Eriosoma** Leach
— Bodies of apterous and alate forms very hairy and not covered with waxy powder or granules (only the stem mothers are weakly pulverulent). Cornicles comparatively large, tuberculate (cone-like). Sexual forms with beaks .... **Anoecia** Koch

The genera *Löwia* Licht., *Pachypappa* Koch. and *Anoecia* Koch are not represented in California. *Colopha* Monell and *Mindarus* Koch are both represented by their type species. It has been proven that *Eriosoma* Leach has priority over *Schizoneura* Hartig, so that genus is now known by that name. It is represented in California by three or four species at present.

42. Genus **Colopha** Monell

Monell, Can. Ent., vol. 9, p. 102, 1877. Type *Byrsocrypta ulmicola* Fitch.

172. **Colopha ulmicola** (Fitch)

Fitch, Rept. Ins. N. Y., vol. 4, p. 63, 1858. *Byrsocrypta* (orig. desc.).
Davidson, Jour. Econ. Ent., vol. 2, p. 299, 1909 (list).
Patch, Maine Agr. Exp. Sta., Bull. 181, 196, 1910 (desc.).

Record.—Ulmus sp.; Stanford University (Davidson).

Davidson recorded this species from elm at Stanford University in 1909. Since then it has not been found again.

43. Genus **Eriosoma** Leach

Leach, Trans. Hort. Soc. London, vol. 3, p. 54, 1820. Type *Aphis lanigerum* Hausman.

Until quite recently this genus has been known as *Schizoneura* Hartig, but as Baker[32] has pointed out, the name *Eriosoma* has priority. In California there are three distinct species represented, with a possible fourth. One of these is known only on elm, one on apple (and elm), and one on pear (and elm).

The following key to the fall migrants is adapted partially from a table of Baker and Davidson.[33]

1. Body naked except caudal segment. Distal sensoria of V and VI with fringe. **languinosa** (Hartig)
— Body with some woolly covering. Distal sensoria without fringe 2
2. Wing veins narrow without brown margins. III longer than IV, V, and VI together .... **lanigerum** (Haus.)
— Wing veins broad with brownish margins. III not so long as IV, V, and VI. **americana** (Riley)

173. **Eriosoma americana** (Riley)

Riley, U. S. Geol. Surv., Bull. 5, p. 4, 1879. *Schizoneura* (orig. desc.).
Clarke, Can. Ent., vol. 35, p. 248, 1903. *Schizoneura* (list).
Patch, Maine Agr. Exp. Sta., Bull. 220, p. 268, 1913. *Schizoneura* (desc. note).

Records.—Ulmus americana; Berkeley (Clarke); Walnut Creek, June, 1915 (Davidson); Palo Alto, May, 1915.

This leaf-curling aphid of the American elm is found in the San Francisco Bay region, and in some cases is very abundant. In May and June, 1915, it was especially so on a row of elms on the campus of Stanford University. At that time stem mothers, nymphs, and alate spring migrants were present in the galls. By the last of June all of these had flown away, leaving the galls empty. According to Baker elm is the only host plant of this species.

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[32] Baker, A. C., The woolly apple aphis, U. S. Dept. Agr., Office Sec'y, Report 101, pp. 11–12, 1915.

[33] Baker, A. C., and Davidson, W. M., Woolly pear aphis, Jour. Agr. Res., vol. 6, p. 358, 1916.

174. **Eriosoma lanigerum** (Hausman)

Hausman, Mag. Ins., vol. 1, p. 440, 1802. *Aphis* (orig. desc.).
Davidson, Jour. Econ. Ent., vol. 2, p. 299, 1909. *Schizoneura* (list).
Davidson, Jour. Econ. Ent., vol. 3, p. 374, 1910. *Schizoneura* (list).
Baker, U. S. Dept. Agr., Office Sec'y, Report 101, pp. 11–16, 1915 (desc. and biology).

Record.—Pyrus malus, throughout the state.

Wherever apple trees are found in the state this woolly aphis is also found; the white masses on the trunks and leaves being very conspicuous, the colonies on the roots more injurious but less conspicuous. In California only the apple has been found to be attacked. The winter is passed by young nymphs on the roots. As the warmer weather of spring comes these migrate up the trunks and out on the branches and twigs. Here they feed throughout the summer. In the fall there is a downward migration, and occasionally a fall migrant is seen. Whether or not these fly to elms as in other parts of the country, is not known, but none have ever been observed on elm.

175. **Eriosoma languinosa** (Hartig)

Hartig, Zeitschr. Ent., vol. 3, p. 359, 1841. *Aphis* (orig. desc.).
Baker and Davidson, Jour. Agr. Res., vol. 6, pp. 351–360, 1916. *E. pyricola* n.sp. (desc.).
Baker and Davidson, Jour. Agr. Res., vol. 10, pp. 65–74, 1917. *E. pyricola* B. & D. (desc. and biology).

Records.—Pyrus communis, Ulmus campestris; central California.

In 1916 Baker and Davidson described a species of *Eriosoma* that attacks the roots of pears throughout the central part of the state, naming it *E. pyricola.* Later Davidson found that a species common on *Ulmus campestris* was the alternate form of this species. This elm form checks up very favorably with specimens of *E. languinosa* Hartig from Europe, and is undoubtedly identical. Thus the name *pyricola* will have to be dropped in favor of *languinosa.* These elm galls are of a rather peculiar shape, and, as Patch writes, they have the appearance of a bonnet.

44. Genus **Mindarus** Koch

Koch, Die Pflanzenläuse, p. 277, 1857. Type *M. abietinus* n.sp.

176. **Mindarus abietinus** Koch

Koch, Die Pflanzenläuse, p. 278, 1857 (orig. desc.).
Clarke, Can. Ent., vol. 35, p. 248, 1903. *Schizoneura panicola* Thos. (list).
Patch, Maine Agr. Exp. Sta., Bull. 182, p. 242, 1910 (desc.).

Records.—Pinus radiata; Berkeley, Palo Alto (Clarke): *Abies cilicia;* Stanford University, May, 1915.

This aphid, easily recognized by the extremely long stigma of the fore wings, has been found in the San Francisco Bay region infesting the shoots of Monterey pine and Cilician fir.

Group **Vacunina** Mordwilko

This group contains but two genera, *Vacuna* Heyden and *Glyphina* Koch. Mordwilko does not recognize *Glyphina* as distinct from *Vacuna*. although Tullgren does. The latter separates the two genera as follows:

1. Last abdominal tergite formed into a knob-shaped tail. Integument bare, and at most partially set with short lancet-shaped hairs. ....**Vacuna** Heyd.
— Last abdominal tergite half-moon shaped, strongly swollen, but scarcely, if at all, separated from the base. Integument set with stiff bristle-like hairs and in apterous females with grain-like elevations...**Glyphina** Koch[34]

45. Genus **Vacuna** Heyden

Heyden, Ent. Beitr., vol. 2, p. 289, 1837. Type *Aphis dryophila* Schrank.

177. **Vacuna dryophila** (Schrank) (?)

Schrank, Fauna Boica, vol. 1, p. 113, 1801. *Aphis* (orig. desc.).
Davidson, Jour. Econ. Ent., vol. 7, p. 128, 1914. *Chaitophorus* sp. (desc.).
Davidson, Jour. Econ. Ent., vol. 10, p. 290, 1917 (desc.).

Record.—Quercus lobata; Walnut Creek (Davidson).

Recently Davidson described this species from specimens taken on valley oak in Contra Costa County, where he had observed it for three years. The single alate female he has taken does not appear identical with European specimens of *V. dryophila*, so he lists the species under this name provisionally.

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[34] This genus is not represented in California.

Subfamily **Phylloxerinae** Dreyfus

This subfamily consists of two groups, the Chermisina and the Phylloxerina. Below is a key to these two groups taken from Van der Goot:

1. Body always with wax glands. Antennae of adults three-jointed, seemingly five-jointed, with three large sensoria. Gonapophyses appearing as three short lips. Sexuales dwarfed, with beak ....Group **Chermisina**

— Body usually without wax glands. Antennae of adults three-jointed, with two large sensoria. Gonapophyses seem to be lacking. Sexuales dwarfed, without beak ....Group **Phylloxerina**

Group **Chermisina** Börner

This group consists of three genera, *Pineus* Shimmer, *Cnaphalodes* Macq., and *Chermes* Linn. as it is generally considered, although some authors add more, as *Gillettea* Del Guercio and *Guercioja* Mordw. In California but one of these genera is represented, and that by but two species.

46. Genus **Chermes** Linnaeus

Linnaeus, Syst. Nat., vol. 10, 1758. Type *Chermes sambuci* Linn.

178. **Chermes cooleyi** Gillette

Gillette, Proc. Acad. Nat. Sci. Phila., vol. 69, p. 3, 1907 (orig. desc.).
Davidson, Jour. Econ. Ent., vol. 2, p. 299, 1909. *C. coweni* Gill. (list).
Davidson, Jour. Econ. Ent., vol. 3, p. 372, 1910. *C. coweni* Gill. (list).
Brannigan, Mon. Bull. Cal. Comm. Hort., vol. 4, p. 285, 1915 (list).

Records.—Pseudotsuga taxifolia, Pinus pinea; San Francisco Bay region, Sacramento Valley.

This species was first reported in California by Davidson, who found it on Douglas fir at Stanford University. Essig lists it from San Francisco, San Mateo, and Santa Clara counties on Douglas fir. In 1915 it was reported twice, once in Sacramento on Douglas fir, and once on Italian stone pine. The author has specimens from E. J. Vosler taken in Sacramento where it was found infesting the twigs and needles of Italian stone pine. Only the apterous females were present, however.

179. **Chermes pinicorticis** Fitch

Fitch, Trans. N. Y. State Agr. Soc., vol. 14, p. 971, 1855. *Coccus* (orig. desc.).
Storment, 20th Ann. Rep. Illinois St. Ent., appendix, 1898 (desc.).
Davidson, Jour. Econ. Ent., vol. 2, p. 299, 1909 (list).
Davidson, Jour. Econ. Ent., vol. 3, p. 372, 1910 (list).

Record.—Pinus pinaster maritima; Stanford University (Davidson).

This species, which is unknown to the author, was reported as present at Stanford University on *Pinus pinaster maritima,* where it was so abundant as to sometimes kill the young trees. For a complete description see Storment's paper listed above.

Group **Phylloxerina** Börner

There are two genera in this tribe, as considered by Börner and Mordwilko, although the American authors have generally taken cognizance of but one, namely, *Phylloxera* Boyer. Below is a key from Mordwilko to these genera.

1. Neither wingless females nor any other forms secreting any waxy material. **Phylloxera** Boyer
— Wingless females secreting a waxy powder .... **Phylloxerina** Börner

47. Genus **Phylloxera** Boyer

Boyer de Fonscolmbe, Ann. Ent. Soc. France, vol. 3, p. 222, 1834. Type *P. quercus* Boyer.

180. **Phylloxera vitifoliae** Fitch

Fitch, Rept. Ins. N. Y., vol. 1, p. 58, 1855 (orig. desc.).
Planchon, C.-R. Acad. Sci. Paris, vol. 67, pp. 588–594, 1868. *P. vastatrix* (desc.).
Clarke, Can. Ent., vol. 35, p. 248, 1903. *P. vastatrix* Plan (list).
Davidson, Jour. Econ. Ent., vol. 2, p. 299, 1909. *P. vastatrix* Plan. (list).
Davidson, Jour. Econ. Ent., vol. 3, p. 372, 1910. *P. vastatrix* Plan. (list).

Records.—Grape; Central and Northern California.

This is the only species of this genus reported in California. It is one of the most destructive species of plant lice in this section of the country, having in its time practically wiped out the grape industry of Santa Clara Valley, and of many other parts of the state. It seems that in California this species infests the roots only of the grape, the forms that produce the leaf galls in the eastern parts of the country not being found here.

48. Genus **Phylloxerina** Börner

Börner, Arbeiter aus d. kais. biol. Anst. f. Land- und Forstwirtschaft, vol. 6, pp. i–v, 81–320, 1908. Type *Phylloxera salicis* Linn.

This genus is represented in California by two species, one found on the stems of cottonwood (*Populus* sp.) and the other on the stems and exposed roots of willow (*Salix* sp.).

181. **Phylloxerina popularia** (Pergande)

Pergrande, Proc. Davenport Acad. Sci., vol. 9, p. 266, 1904. *Phylloxera* (orig. desc.).
Davidson, Jour. Econ. Ent. vol. 8, p. 420, 1915. *Phylloxera* (list).

Records.—*Populus* spp.; Walnut Creek (Davidson), Merced (Beers).

The only report of this species in California is the one of Davidson who found it on *Populus fremonti* and *Populus trichocarpa* at Walnut Creek. On October 14, 1915, A. A. Beers of Merced sent some specimens to the author from balm of Gilead (*Populus balsamifera*) in Merced. These were all apterous females, and were found in great masses of white wax on the smaller branches and twigs. These reports are the only ones since its original report from Texas and Louisiana by Pergande.

182. **Phylloxrina salicola** (Pergande)

Pergande, Proc. Davenport Acad. Sci., vol. 9, p. 267, 1904. *Phylloxera* (orig. desc.).
Davidson, Jour. Econ. Ent., vol. 8, p. 419, 1915. *Phylloxera* (list).

Records.—*Salix* spp.; Walnut Creek (Davidson); Pasadena (Smith).

This species was also reported from Walnut Creek by Davidson on arroyo willow (*Salix lasiolepis*) where he found it on the stems and exposed roots. On October 13, 1915, A. G. Smith sent the author specimens from an ornamental willow (*Salix* sp.) in Pasadena, where he found it very abundantly that fall. The specimens were all apterous females, and were found in the midst of considerable masses of wax. This species has only been reported from Illinois, District of Columbia, and California.

APPENDIX 1

KEYS TO THE GENERA AND TRIBES OF APHIDIDAE

BY

P. VAN DER GOOT, 1913

Subfamily APHIDINAE

1. Antennae seven-jointed (better six-jointed). The last true joint with a distinct, more delicate continuation (terminal process). This continuation almost as long as, or even much longer than the last segment; if shorter, the cauda is distinctly wart-shaped, and the number of rudimentary gonapophyses is always two. Cornicles almost always well formed and clearly projecting. Wings with twice-branched cubitus, only once-branched in exceptional cases 2

— Antennae mostly six-jointed, the last joint with a short projection, this being usually distinctly shorter than half the last segment. Cornicles scarcely projecting, very often only appearing as pores or entirely absent. Wings with a simple or once-branched cubitus 5

2. Cauda wart-like, occasionally not so, or scarcely separated, but then the number of rudimentary gonapophyses is always distinctly two 3

— Cauda sickle-shaped or knobbed, not wart-like, only very seldom absent. Rudimentary gonapophyses always three .... **Siphonophorina**

3. Cornicles very long, almost cylindrical. Rudimentary gonapophyses three. **Drepanosiphina**

— Cornicles very short, somewhat clubbed. Rudimentary gonapophyses two or four 4

4. Number of rudimentary gonapophyses four. Body never with long clubbed hairs .... **Chaitophorina**

— Number of rudimentary gonapophyses two. Body often with knobbed hairs. Tarsi always with two pulvillae [Haftlappchen] .... **Callipterina**

5. Cauda wart-like 6

— Cauda not wart-like, usually absent 7

6. Anal plate bilobed. Sensoria of alate females linear .... **Hormaphidina**

— Anal plate simple. Sensoria of alate females circular .... **Vacunina** p.p.

7. Cauda distinctly sickle-shaped .... **Mindarina**

— Cauda only scarcely or not at all separated 8

8. Antennae five-jointed. Cornicles very short, only slightly projecting. Body without distinct wax gland groups .... **Vacunina** p.p.

— Antennae six-jointed, those of the apterous forms often only four- or five-jointed. Cornicles often only pores or entirely lacking. Body often with wax gland 9

9. Body with long, mostly fine hairs; without distinctly facetted wax gland plates. Primary sensoria almost always without hairy edges 10

— Body naked; very often with distinctly facetted wax-gland plates. Primary sensoria often with hairy edges 11

10. Rudimentary gonapophyses three. Wings mostly with twice-branched cubitus. Cornicles always prominent .... **Lachnina**

— Rudimentary gonapophyses none. Wings with simple or once-branched cubitus. Cornicles often absent .... **Anoeciina**

11. Rudimentary gonapophyses three. Facets of wax-gland plates almost equal-sized. Wings with simple cubitus. Sensoria of alate forms long oval, not linear .... **Pemphigina**
— Rudimentary gonapophyses none. Wax gland plates always with at least one large central facet. Sensoria of alate forms linear. Wings with simple or once-branched cubitus .... **Schizoneurina**

Subfamily CHERMISINAE

1. Rudimentary gonapophyses appearing as three short cones. Wax glands almost always present .... **Chermisina**
— Rudimentary gonapophyses seemingly lacking. Wax glands mostly absent. **Phylloxerina**

Group SIPHONOPHORINA

1. Apterous forms with a few sensoria on the third antennal segment. Antennal tubercles usually well formed. Body almost never with lateral tubercles, in any case these are never formed on the seventh abdominal segment 2
— Apterous forms without sensoria on the third antennal segment. Antennal tubercles often small or absent. Body with lateral tubercles 4
2. Cornicles almost cylindrical, or rarely somewhat swollen on the side, but then the body is covered with capitate hairs 3
— Cornicles distinctly clavate. Body almost bare, never with capitate hairs. **Rhopalosiphum** Koch
Type *Amphorophora ampullata* Buckton.
3. Body of apterous forms with long capitate hairs. First antennal joint drawn out, somewhat tooth-shaped on the inner side .... **Myzus** Passerini
Type *Aphis ribis* Linn.
— Body of apterous forms bare or without capitate hairs. First antennal joint never drawn out, tooth-like .... **Macrosiphum** Passerini
Type *Aphis millifolii* Fabr.
4. Body of apterous forms with capitate hairs. First antennal joint more or less toothed on inner side .... **Capitophorus** n.gn.
Type *Phorodon carduinum* Walker.
— Body of apterous forms without capitate hairs. First antennal joint not toothed 5
5. Body with many long delicate hairs. Cornicles short, somewhat swollen. **Cladobius** (Koch.) Pass.
Type *Aphis populea* Kalt.
— Body bare or almost so 6
6. Cornicles almost as long or longer than cauda 7
— Cornicles much shorter than cauda 16
7. Cornicles always distinctly clavate .... **Siphocoryne** Pass.
Type *Aphis avenae* Fabr.
— Cornicles cylindrical or conical 8
8. Antennal tubercles well formed, very distinctly toothed on the inner side. Tubercles on the side of the body always absent 9
— Antennal tubercles mostly small or lacking, never distinctly toothed. Body often with lateral tubercles 10
9. Antennal tubercles very strongly toothed, the first joint being distinctly toothed on the inner side .... **Phorodon** Pass.
Type *Aphis humuli* Schr.
— Antennal tubercles only slightly toothed, first antennal joint being rounded or flat on the inner side, never toothed .... **Ovatus** n.gn.
Type *Ovatus mespili* v. d. G.

10. Antennal tubercles well formed, strongly rounded on the inner side.
Type *Aphis cerasi* Fabr. **Myzoides** n.gn.

— Antennal tubercles small or lacking, never drawn out distinctly on inner side 11

11. Body with small tubercles on the middle of the seventh and eighth abdominal segments, and often also on the head and prothorax ....**Dentatus** n.gn.
Type *Aphis sorbi* Kalt.

— Body without tubercles on the middle of the seventh and eighth abdominal segments 12

12. Cubitus of fore wing only once-branched ....**Toxoptera** Koch
Type *Toxoptera graminum* (Rond.).

— Cubitus of fore wing always twice-branched. Body often with lateral tubercles 13

13. Cornicles short, always distinctly conical. Cauda very short, broad with rounded tip, usually approximately the length of the cornicles, or entirely lacking. Lateral tubercles lacking or only indistinctly formed on the anterior abdominal segments 15

— Cornicles long, almost cylindrical. Cauda sickle- or club-shaped, usually distinctly shorter than cornicles 14

14. Body long without lateral tubercles. Front often with a very distinct tubercle in the middle ....**Myzaphis** n.gn.
Type *Aphis rosarum* Walker.

— Body more rounded, with lateral tubercles. Front usually flat, never with a distinct tubercle ....**Aphis** Linn.
Type *Aphis rumicis* Linn.

15. Cauda distinctly separated, almost as long as broad ....**Brachycaudus** n.gn.
Type *Aphis myosotidis* Koch.
(*Aphis cardui* Linn. belongs in this genus.)

— Cauda lacking or scarcely separated, much shorter than broad ....**Acaudus** n.gn.
Type *Aphis lychnidis* Linn.

16. Cornicles distinctly longer than broad. Cauda usually not conical 17

— Cornicles extremely short, scarcely projecting, cylindrical, usually nearly as long as broad. Cauda always conical with broad base 19

17. Cornicles only a little longer than broad, distinctly conical. Cauda sickle- or club-shaped ....**Longicaudis** n.gn.
Type *Hyalopterus trirhodus* (Walker).

— Cornicles cylindrical, at least twice as long as broad 18

18. Body with lateral tubercles on first and seventh abdominal segments. Cauda small, club-shaped ....**Hyalopterus** Koch
Type *Aphis pruni* Fabr.

— Body without lateral tubercles on first and seventh abdominal segments. Cauda conical ....**Semiaphis** n.gn.
Type *Aphis carotae* Koch.

19. Body long, without lateral tubercles. Antennae short, at the most about half the length of the body ....**Brachycolus** Buckton
Type *Brachycolus stellariae* (Hardy).

— Body oval with lateral tubercles on prothorax, first and seventh abdominal segments. Antennae at least about three-fourths as long as the body.
Type *Aphis thalictri* Koch. **Brachysiphum** n.gn.

Group Drepanosiphina

Genus *Drepanosiphum* Koch. Type *Drepanosiphum platanoides* Schrank.

Group CALLIPTERINA

1. Antennae six-jointed. Cornicles merely pores. Body always with wax glands .... **Phyllaphis** Koch
Type *Phyllaphis fagi* (Linn.).

— Antennae seven-jointed, the terminal process at least one-half as long as the preceding joint. Cornicles always distinctly projecting. Body almost always without wax glands, these always of similar shape 2

2. Seventh antennal joint distinctly longer than sixth 3

— Seventh antennal joint only as long as, or shorter than sixth 6

3. Cornicles but slightly projecting. Antennae curved as in beetles. **Bradyaphis** Mord.
Type *Bradyaphis antennata* (Kalt.).

— Cornicles distinctly prominent. Antennae straight 4

4. Anal plate only slightly emarginate, never bilobed. Body with tolerably stiff hairs, these are never capitate. Apterous forms always with sensoria on third antennal joint .... **Callipterinella** n.gn.
Type *Callipterus betularius* Kalt.

— Anal plate distinctly bilobed. Body bare or with capitate hairs 5

5. Apterous forms without sensoria on third antennal joint. The body always with capitate hairs .... **Callipterus** Koch
Type *Callipterus coryli* (Goetze).

— Apterous forms with a few sensoria on third antennal joint. Body with distinct tubercles .... **Tuberculatus** Mord.
Type *Tuberculatus betulicolus* (Kalt.).

6. Anal plate distinctly bilobed 8

— Anal plate always simple 7

7. Cauda wart-like, distinctly separated from base. Apterous forms without sensoria on third antennal joint .... **Callipteroides** Mord.
Type *Callipterus betulae* Koch.

— Cauda scarcely visible. Sensoria present on third antennal joint of apterous forms .... **Symydobius** Mord.
Type *Symydobius oblongus* (Heyden).

8. Seventh antennal joint nearly as long as the sixth. Wings with only very small black spots at the tip of the veins .... **Subcallipterus** Mord.
Type *Callipterus alni* (Fabr.).

— Seventh antennal joint nearly half as long as sixth. Wings black spotted. **Pterocallis** Pass.
Type *Pterocallis tiliae* (Linn.).

Group CHAITOPHORINA

1. Body with long delicate hairs. Antennae seven-jointed. Cornicles well developed 2

— Body with short thorn-like hairs. Antennae six-jointed, the terminal process always distinctly longer than the preceding joint. Cornicles only slightly projecting .... **Sipha** Passerini
Type *Sipha glyceriae* (Kalt.).

2. Tarsi with two "Haftläppchen" [i.e., the empodial hair is spatula-like]. **Chaitophorinella** n.gn.
Type *Chaitophorus testudinatus* (Thornton).

— Tarsi without "Haftläppchen" [i.e. the empodial hair is bristle-like]. **Chaitophorus** Koch
Type *Chaitophorus leucomelas* Koch.

Group LACHNINA

1. Wings usually with twice-branched cubitus, the radius always straight. Cauda not at all or only slightly separated .... **Lachnus** Ill.
Type *Lachnus juniperi* De Geer.
— Wings with once- or twice-branchel cubitus and with a curved radius; the membrane usually with dusky markings. Cauda usually slightly separated 2
2. Beak distinctly longer than the body, strongly retractile. Cubitus but once-branched, the wings only slightly darkened .... **Stomaphis** Buckton
Type *Stomaphis quercus* (Linn.).
— Beak clearly shorter than body and only slightly retractile. Wings beautifully spotted with dark brown 3
3. Cubitus twice-branched .... **Dryobius** Koch
Type *Dryobius croaticus* Koch.
— Cubitus once-branched .... **Schizodryobius** n.gn.
Type *Lachnus exsiccator* Hart.

Tribe ANOECIINA

1. Hind tarsi elongate .... **Trama** Heyden
Type *Trama radicis* Koch.
— Hind tarsi not elongate 2
2. Cubitus once-branched. Cornicles present, quite prominent. Margin of body with peculiar non-faceted "wax-gland" (?) plates .... **Anoecia** Koch
Type *Anoecia corni* (Fabr.).
— Cubitus not branched. Cornicles absent. Wax gland plates not present.
Tullgrenia v. d. G.
Type *Tullgrenia phaseoli* (Pass.).

Tribe HORMAPHIDINA

1. Antennae always five-segmented. The fronds almost without exception with two little horns. Cubitus once branched .... **Cerataphis** Licht.
Type *C. lataniae* Boisd.
— Antennae of the apterae often only three-segmented. Fronds without protuberances. Cubitus simple .... **Hamamelistes** Schim.
Type *H. betulae* Mordw.

APPENDIX 2

HOST PLANT LIST OF CALIFORNIA APHIDIDAE[35]

- *Abies* (fir)
  - 45. *Lachnus ferrisi* Swain
  - 47. *Lachnus occidentalis* Dvdn.
  - 176. *Mindarus abietinus* Koch
- *Abutilon* (Indian mallow)
  - 146. *Aphis senecio* Swain
  - 104. *Rhopalosiphum persicae* (Sulz.)
- *Acer* (maple, box elder)
  - 5. *Drepanaphis acerifolii* (Thomas)
  - 4. *Drepanosiphum platanoides* (Schrank)
  - 33. *Thomasia negundinis* (Thomas)
- *Achillea* (yarrow)
  - 79. *Macrosiphum solanifolii* (Ashmead)
- *Aegopodium* (goutweed)
  - 108. *Siphocoryne capreae* (Fabr.)
- *Aesculus* (California buckeye)
  - 88. *Myzus circumflexus* (Buckton)
  - 171. *Prociphilus venafuscus* Patch
- Alder, see *Alnus*
- Alfalfa, see *Medicago*
- Alfilerilla, see *Erodium*
- *Alisma* (water plantain)
  - 156. *Siphocoryne nymphaeae* (Linn.)
- Almond, see *Prunus*
- *Alnus* (Alder)
  - 9. *Eucallipterus flava* (Davidson)
  - 8. *Euceraphis gillettei* Davidson
  - 11. *Myzocallis alnifoliae* (Fitch)
- *Alopecurus* (foxtail)
  - 68. *Macrosiphum granarium* (Kirby)
  - 88. *Myzus circumflexus* (Buckton)
- *Althaea* (hollyhock)
  - 121. *Aphis euonomi* Fabr.
- Alum root, see *Heuchera*

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[35] In the following list only the generic and common names of the plants are employed, the various species of plants being omitted. Although in certain cases aphids are restricted to certain species, as *Eriosoma languinosa* Hartig on *Pyrus communis* but not on *Pyrus malus*, these are in the minority. The botanical names are taken from the following works, with preference as in the order listed:

Bailey, L. H., Standard cyclopedia of horticulture, vols. 1–6, New York, Macmillan, 1914–1917.

Robinson, B. L., and Fernald, M. L., Gray's New manual of botany, ed. 7, Cambridge, Harvard University, 1908.

Jepson, W. L., A flora of western middle California, ed. 2, San Francisco, Cunningham, 1911.

Abrams, LeRoy, Flora of Los Angeles and vicinity, Palo Alto, Stanford University Press, 1904.

- *Amaranthus* (pigweed)
  - 123. *Aphis gossypii* Glover
  - 132. *Aphis middletonii* Thomas
  - 104. *Rhopalosiphum persicae* (Sulz)
  - 163. *Trifidaphis radicicola* (Essig)
- *Ambrosia* (ragweed)
  - 146. *Aphis senecio* Swain
  - 77. *Macrosiphum rudbeckiae* (Fitch)
- *Ampelodesma*
  - 68. *Macrosiphum granarium* (Kirby)
- *Amsinckia* (amsinckia)
  - 146. *Aphis senecio* Swain
  - 104. *Rhopalosiphum persicae* (Sulz.)
- *Angelica* (angelica)
  - 109. *Aphis angelicae* Koch
  - 115. *Aphis cari* Essig
  - 108. *Siphocoryne capreae* (Fabr.)
- Anise, Wild, see *Carum*
- *Anthemis* (chamomile)
  - 121. *Aphis euonomi* Fabr.
  - 146. *Aphis senecio* Swain
  - 123. *Aphis gossypii* Glover
- Apple, see *Pyrus*
- Apricot, see *Prunus*
- *Aquilegia* (columbine)
  - 85. *Myzus aquilegiae* Essig
- Arbor vitae, see *Thuja* sp.
- *Arbutus* (madroñe, strawberry tree)
  - 103. *Rhopalosiphum nervatum* Gillette
- *Arctostaphylos* (manzanita)
  - 1. *Phyllaphis coweni* (Cockerell)
  - 103. *Rhopalosiphum nervatum* Gillette
- *Artemisia* (sagebrush, oldman, California mugwort, etc.)
  - 122. *Aphis frigidae* Oestlund
  - 131. *Aphis medicaginis* Koch
  - 137. *Aphis oregonensis* Wilson
  - 146. *Aphis senecio* Swain
  - 61. *Macrosiphum artemisiae* (Fonsc.)
  - 62. *Macrosiphum artemisicola* (Williams)
  - 72. *Macrosiphum ludovicianiae* (Oestlund)
- Artichoke, see *Cynara*
- *Arundinaria* (bamboo)
  - 12. *Myzocallis arundicolens* (Clarke)
  - 13. *Myzocallis arundinariae* Essig
- *Arundo* (giant reed)
  - 12. *Myzocallis arundicolens* (Clarke)
  - 13. *Myzocallis arundinariae* Essig
- *Asclepias* (milkweed)
  - 123. *Aphis gossypii* Glover
  - 135. *Aphis nerii* Fonsc.
  - 102. *Rhopalosiphum lactucae* (Kalt.)

- Ash, see *Fraxinus*
- *Arparagus* (asparagus, smilax, asparagus fern)
  - 123. *Aphis gossypii* Glover
  - 88. *Myzus circumflexus* (Buckton)
- *Aster* (aster)
  - 132. *Aphis middletonii* Thomas
  - 146. *Aphis senecio* Swain
- *Astragalus* (loco weed)
  - 131. *Aphis medicaginis* Koch
- *Atriplex* (orache)
  - 147. *Aphis tetrapteralis* Cockerell
  - 79. *Macrosiphum solanifolii* (Ashmead)
- Avocado, see *Persea*
- *Avena* (oats)
  - 111. *Aphis avenae* Fabr.
  - 68. *Macrosiphum granarium* (Kirby)
  - 105. *Rhopalosiphum rhois* Monell
- *Baccharis* (groundsel)
  - 146. *Aphis senecio* Swain
  - 63. *Macrosiphum baccharadis* (Clarke)
  - 77. *Macrosiphum rudbeckiae* (Fitch)
  - 104. *Rhopalosiphum persicae* (Sulz.)
- Bamboo, see *Arundinaria*, *Bambusa*, and *Phyllostachys*
- *Bambusa* (bamboo)
  - 12. *Myzocallis arundicolens* (Clarke)
- Banana, see *Musa*
- Barberry, see *Berberis*
- Barley, see *Hordeum*
- Basswood, see *Tilia*
- Bean, see *Phaseolus*
- Bean, Blackeye, see *Vigna*
- Bean, Broad, see *Vicia*
- Beech, see *Fagus*
- Beet, see *Beta*
- *Begonia* (begonia)
  - 123. *Aphis gossypii* Glover
- Bell, fairy, see *Dipsorum*
- *Berberis* (barberry)
  - 154. *Liosomaphis berberidis* (Kalt.)
- *Beta* (beet, sugarbeet)
  - 124. *Aphis gossypii* Glover
  - 164. *Pemphigus betae* Doane
- *Betula* (birch)
  - 6. *Calaphis betulaecolens* (Fitch)
  - 27. *Callipterinella annulata* (Koch)
  - 7. *Euceraphis betulae* (Koch)
- Birch, see *Betula*
- Blackberry, see *Rubus*
- *Bougainvillea* (bougainvillea)
  - 104. *Rhopalosiphum persicae* (Sulz.)
- Boxelder, see *Acer*

- *Brassica* (cabbage, mustard, turnip, etc.)
  - 112. *Aphis brassicae* Linn.
  - 144. *Aphis pseudobrassicae* Davis
  - 166. *Pemphigus populi-transversus* Riley (?)
  - 102. *Rhopalosiphum lactucae* (Kalt.)
  - 104. *Rhopalosiphum persicae* (Sulz.)
- Broom, see *Cytisus*
- Buckeye, California, see *Aesculus*
- Buckton, see *Rhamnus*
- Bur clover, see *Medicago*
- Buttercup, see *Ranunculus*
- Cabbage, see *Brassica*
- *Calendula* (marigold)
  - 113. *Aphis calendulicola* Monell
  - 121. *Aphis euonomi* Fabr.
  - 146. *Aphis senecio* Swain
- California buckeye, see *Aesculus*
- California holly, see *Heteromeles*
- California mugwort, see *Artemesia*
- California poppy, see *Eschscholtzia*
- California sagebrush, see *Artemisia*
- California tule, see *Typha*
- Calla, see *Zantedeschia*
- *Camellia* (camellia)
  - 152. *Toxoptera aurantii* (Fonsc.)
- Canary grass, see *Phalaris*
- Cantaloupe, see *Cucumis*
- *Capsella* (shepard's purse)
  - 112. *Aphis brassicae* Linn.
  - 123. *Aphis gossypii* Glover
  - 141. *Aphis pseudobrassicae* Davis
  - 104. *Rhopalosiphum persicae* (Sulz.)
- *Capsicum* (pepper pimento)
  - 104. *Rhopalosiphum persicae* (Sulz.)
- *Caragana* (pea tree)
  - 131. *Aphis medicaginis* Koch.
- *Carum* (wild anise)
  - 115. *Aphis cari* Essig
  - 155. *Siphocoryne capreae* (Fabr.)
- *Castanea* (chestnut)
  - 15. *Myzocallis castanicola* Baker (*davidsoni* Swain)
- *Catalpa* (catalpa)
  - 123. *Aphis gossypii* Glover
  - 139. *Aphis pomi* de Geer
  - 104. *Rhopalosiphum persicae* (Sulz.)
- Cauliflower, see *Brassica*
- *Ceanothus* (mountain lilac)
  - 116. *Aphis ceanothi* Clarke
- *Centaurea* (tacalote)
  - 130. *Aphis marutae* Oestlund
- *Centranthus* (red valerian)
  - 76. *Macrosiphum rosae* (Linn.)
  - 104. *Rhopalosiphum persicae* (Sulz.)

- *Chaerophyllum*
  - 155. *Siphocoryne capreae* (Fabr.)
- Chamomile, see *Anthemis*
- Chaparral broom, see *Baccharis*
- Charlock, see *Brassica*
- Cheeseweed, see *Malva*
- *Cheiranthus* (wallflower)
  - 88. *Myzus circumflexus* (Buckton)
- *Chenopodium* (lamb's-quarters, pigweed)
  - 110. *Aphis atriplicis* Linn.
  - 123. *Aphis gossypii* Glover
  - 124. *Aphis hederae* Kalt. (?)
  - 164. *Pemphigus betae* Doane (?)
  - 104. *Rhopalosiphum persicae* (Sulz.)
- Cherry, see *Prunus*
- Cherry, wild, see *Prunus*
- Chestnut, see *Castanea*
- Chestnut, Horse, see *Aesculus*
- Chicory, see *Chicorium*
- Christmas berry, see *Heteromeles*
- *Chrysanthemum* (chrysanthemum)
  - 56. *Amphorophora latysiphon* Davidson
  - 123. *Aphis gossypii* Glover
  - 146. *Aphis senecio* Swain
  - 160. *Coloradoa rufomaculata* Wilson
  - 77. *Macrosiphum rudbeckiae* (Fitch)
  - 78. *Macrosiphum sanborni* Gillette
- *Cichorium* (chicory)
  - 71. *Macrosiphum lactucae* (Kalt.)
- *Cicuta* (water hemlock)
  - 155. *Siphocoryne capreae* (Fabr.)
- *Cirsium* (thistle)
  - 144. *Aphis cardui* Linn.
- *Citrullus* (watermelon)
  - 123. *Aphis gossypii* Glover
- *Citrus* (citrus, orange, lemon, etc.)
  - 118. *Aphis cooki* Essig
  - 123. *Aphis gossypii* Glover
  - 131. *Aphis medicaginis* Koch
  - 79. *Macrosiphum solanifolii* (Ashmead)
  - 104. *Rhopalosiphum persicae* (Sulz.)
  - 152. *Toxoptera aurantii* (Fonsc.)
- *Clarkia* (clarkia)
  - 104. *Rhopalosiphum persicae* (Sulz.)
- *Clematis* (clematis)
  - 94. *Myzus varians* Davidson
- Clover, see *Trifolium*
- Clover, Sweet, see *Melilotus*
- Coffeeberry, see *Rhamnus*
- Columbine, see *Aquilegia*
- *Compositae* (various species)
  - 131. *Aphis medicaginis* Koch
  - 65. *Macrosiphum chrysanthemi* (Oestlund)
  - 77. *Macrosiphum rudbeckiae* (Fitch)

- *Conium* (poison hemlock)
  - 159. *Siphocoryne pastinacae* (Linn.)
- *Convolvulus* (morning glory)
  - 56. *Amphorophora latysiphon* Davidson
  - 123. *Aphis gossypii* Glover
  - 72. *Macrosiphum ludovicianae* (Oestlund)
- Corn, see *Zea*
- *Cornus* (dogwood)
  - 119. *Aphis cornifoliae* Fitch
  - 123. *Aphis gossypii* Glover
- *Corylus* (hazelnut)
  - 16. *Myzocallis coryli* (Goetze)
  - 100. *Rhopalosiphum corylinum* Davidson
- *Cotoneaster* (cotoneaster)
  - 139. *Aphis pomi* de Geer
- Cotton, see *Gossypium*
- Cottonwood, see *Populus*
- Cow parsnip, see *Heracleum*
- Cowpea, see *Vigna*
- Cowslip, see *Primula*
- Crab apple, see *Pyrus*
- Cranesbill, see *Geranium*
- *Crataegus* (hawthorn)
  - 120. *Aphis crataegifoliae* Fitch
  - 139. *Aphis pomi* de Geer
- *Cruciferae* (various spp.)
  - 112. *Aphis brassicae* Linn.
  - 141. *Aphis pseudobrassicae* Davis
- Cucumber, see *Cucumis*
- *Cucumis* (cucumber, muskmelon, cantaloupe, etc.)
  - 123. *Aphis gossypii* Glover
- *Cucurbita* (squash, gourd, pumpkin, etc.)
  - 123. *Aphis gossypii* Glover
  - 66. *Macrosiphum cucurbitae* (Thomas)
- *Cupressus* (cypress)
  - 161. *Cerosipha cupressi* Swain
  - 96. *Macrosiphum morrisoni* Swain
- Currant, see *Ribes*
- *Cydonia* (quince)
  - 139. *Aphis pomi* De Geer
- *Cynara* (artichoke)
  - 86. *Myzus braggii* Gillette
- *Cynoglossum* (houndstongue)
  - 104. *Rhopalosiphum persicae* (Sulz.)
- Cypress, see *Cupressus*
- *Cyrtomium* (holly fern)
  - 162. *Cerataphis lataniae* (Boisd.)
  - 58. *Idiopterus nephrelepidis* Davis
  - 88. *Myzus circumflexus* (Buckton)
- *Cytisus* (broom)
  - 146. *Aphis senecio* Swain
  - 104. *Rhopalosiphum persicae* (Sulz.)

Dandelion, see *Taraxacum*
Datura (jimson weed)
  123. *Aphis gossypii* Glover
Deinandra
  79. *Macrosiphum solanifolii* (Ashmead)
Digitalis (foxglove)
  88. *Myzus circumflexus* (Buckton)
Dipsacus (fuller's teasel)
  76. *Macrosiphum rosae* (Linn.)
  77. *Macrosiphum rudbeckiae* (Fitch)
  104. *Rhopalosiphum persicae* (Sulz.)
Disporum (fairy bell)
  79. *Macrosiphum solanifolii* (Ashmead)
Dock, see *Rumex*
Dogwood, see *Cornus*
Douglas fir, see *Pseudotsuga*
Dracaena (dragon tree)
  111. *Aphis avenae* Fabr.
Dragon tree, see *Dracaena*
Elderberry, see *Sambucus*
Elm, see *Ulmus*
Elymus (wild rye)
  68. *Macrosiphum granarium* (Kirby)
English ivy, see *Hedera*
Epilobium (fireweed)
  136. *Aphis oenotherae* Oestlund
Eriobotrya (loquat)
  139. *Aphis pomi* de Geer
Erodium (alfilerilla)
  79. *Macrosiphum solanifolii* (Ashmead)
  104. *Rhopalosiphum persicae* (Sulz.)
Erysimum (western wallflower)
  155. *Siphocoryne capreae* (Fabr.)
Escallonia (escallonia)
  104. *Rhopalosiphum persicae* (Sulz.)
Eschscholtzia (California poppy)
  123. *Aphis gossypii* Glover
Everlasting, see *Gnaphalium*
Fagus (beech)
  2. *Phyllaphis fagi* (Linn.)
Fairybell, see *Dipsorum*
Fennel, see *Foeniculum*
Fenugreek, see *Trigonella*
Fern, asparagus, see *Asparagus*
Fern, Boston, see *Nephrolepis*
Fern, holly, see *Cyrtomium*
Fig marigold, see *Mesembryanthemum*
Figwort, see *Scrophularia*
Fir, see *Abies*
Fir, Douglas, see *Pseudotsuga*
Fireweed, see *Epilobium*
Foeniculum (fennel)
  155. *Siphocoryne capreae* (Fabr.)

- Foxglove, see *Digitalis*
- Foxtail, see *Alopecurus*
- *Fragaria* (strawberry)
  - 90\. *Myzus fragaefolii* Cockerell
- *Fraxinus* (ash)
  - 171\. *Prociphilus venafuscus* Patch
  - 167\. *Thecabius californicus* (Davidson)
- Fuller's teasel, see *Dipsacus*
- *Fuchsia* (fuchsia)
  - 79\. *Macrosiphum solanifolii* (Ashmead)
  - 88\. *Myzus circumflexus* (Buckton)
- Gambleweed, see *Sanicula*
- Geranium, see *Pelargonium*
- *Geranium* (cranesbill)
  - 104\. *Rhopalosiphum persicae* (Sulz.)
- German ivy, see *Senecio*
- *Gladiolus* (gladiolus)
  - 88\. *Myzus circumflexus* (Buckton)
- *Glycyrrhiza* (liquorice)
  - 131\. *Aphis medicaginis* Koch
- *Gnaphalium* (everlasting)
  - 146\. *Aphis senecio* Swain
  - 60\. *Macrosiphum ambrosiae* (Thomas)
- Gooseberry, see *Ribes*
- Goosefoot, see *Chenopodium*
- *Gossypium* (cotton)
  - 123\. *Aphis gossypii* Glover
- Gourd, see *Cucurbita*
- Goutweed, see *Aegopodium*
- *Graminaceae* (various species)
  - 111\. *Aphis avenae* Fabr.
  - 67\. *Macrosiphum dirhodum* (Walker)
  - 68\. *Macrosiphum granarium* (Kirby)
  - 105\. *Rhopalosiphum rhois* Monell
- Grape, see *Vitis*
- *Grindelia* (marsh grindelia)
  - 146\. *Aphis senecio* Swain
- Hawthorn, see *Crataegus*
- Hazelnut, see *Corylus*
- *Hedera* (English ivy)
  - 109\. *Aphis angelicae* Koch
  - 124\. *Aphis hederae* Kalt
  - 104\. *Rhopalosiphum persicae* (Sulz.)
- Hedge mustard, see *Sisymbrium*
- Hedge nettle, see *Stachys*
- *Helianthus* (sunflower)
  - 123\. *Aphis gossypii* Glover
  - 132\. *Aphis middletonii* Thomas
  - 146\. *Aphis senecio* Swain
  - 60\. *Macrosiphum ambrosiae* (Thomas)
  - 77\. *Macrosiphum rudbeckiae* (Fitch)
  - 104\. *Rhopalosiphum persicae* (Sulz.)

Hemlock, Poison, see *Conium*
Hemlock, Water, see *Cicuta*
Heracleum (cow parsnip)
123. *Aphis gossypii* Glover
125. *Aphis heraclei* Cowen
Heteromeles (California holly, Christmas berry)
170. *Prociphilus alnifoliae* (Williams)
103. *Rhopalosiphum nervatum* Gillette
Heuchera (alum root)
69. *Macrosiphum heucherae* (Thomas)
Hibiscus (rose mallow)
121. *Aphis euonomi* Fabr.
Holly fern, see *Cyrtonium*
Hollyhock, see *Althaea*
Holly, mountain, see *Heteromeles*
Honey flower, see *Melianthus*
Honeysuckle, see *Lonicera*
Hop, see *Humulus*
Hordeum (barley)
111. *Aphis avenae* Fabr.
68. *Macrosiphum granarium* (Kirby)
Houndstongue, see *Cynoglossum*
Humulus (hop)
123. *Aphis gossypii* Glover
98. *Phorodon humuli* (Schrank)
Hydrangea (hydrangea)
123. *Aphis gossypii* Glover
Indian mallow, see *Abutilon*
Ironweed, see *Veronina*
Ivy, Engislh, see *Hedera*
Ivy, German, see *Senecio*
Jasminum (jessamine)
70. *Macrosiphum jasmini* (Clarke)
Jessamine, see *Jasminum*
Jimpson weed, see *Datura*
Juglans (walnut)
24. *Callipterus californicus* (Essig)
25. *Callipterus caryae* Monell
23. *Chromaphis juglandicola* (Kalt.)
26. *Monellia caryella* (Fitch)
Knotweed, see *Polygonum*
Lactuca (lettuce)
79. *Macrosiphum solanifolii* (Ashmead)
Lamb's-quarters, see *Chenopodium*
Lathyrus (sweet pea)
74. *Macrosiphum pisi* (Kalt.)
Laurel, see *Laurus*
Laurel, California, see *Umbellularia*
Laurestinus, see *Viburnum*
Laurus (laurel)
150. *Aphis viburnicolens* n.sp.

- *Lavatera* (tree mallow)
  - 104. *Rhopalosiphum persicae* (Sulz.)
- Leather root, see *Psorales*
- Lemon, see *Citrus*
- *Lepidium* (peppergrass)
  - 123. *Aphis gossypii* Glover
- Lettuce, see *Lactuca*
- *Ligusticum* (lovage)
  - 155. *Siphocoryne capreae* (Fabr.)
- Lilac, see *Syringa*
- Lilac, Mountain, see *Ceanothus*
- *Lilium* (lily)
  - 123. *Aphis gossypii* Glover
  - 88. *Myzus circumflexus* (Buckton)
- Lily, see *Lilium*
- Lily, Water, see *Nymphaea*
- Linden, see *Tilia*
- Liquorice, see *Glycyrrhiza*
- *Liriodendron* (tulip tree)
  - 104. *Rhopalosiphum persicae* (Sulz.)
- *Lithospermum*
  - 127. *Aphis lithospermi* Wilson
- Loco weed, see *Astragalus*
- Locust, see *Robinia*
- Loganberry, see *Rubus*
- *Lonicera* (honeysuckle)
  - 157. *Siphocoryne pastinacae* (Linn.)
- Loquat, see *Eriobotrya*
- Lovage, see *Ligusticum*
- *Lupinus* (lupine)
  - 59. *Macrosiphum albifrons* Essig
- *Lycopersicum* (tomato)
  - 91. *Myzus lycopersicae* (Clarke)
  - 104. *Rhopalosiphum persicae* (Sulz.)
- *Madia* (tarweed)
  - 77*a*. *Macrosiphum rudbeckiae* (Fitch) var. *madia* n.var.
- Madron, see *Arbutus*
- Mallow, Indian, see *Abutilon*
- Mallow, Rose, see *Hibiscus*
- Mallow tree, see *Lavatera*
- *Malva* (cheeseweed)
  - 121. *Aphis euonomi* Fabr.
  - 123. *Aphis gossypii* Glover
  - 104. *Rhopalosiphum persicae* (Sulz.)
- Manzanita, see *Arctostaphylos*
- Maple, see *Acer*
- Marigold, see *Calendula*
- Marigold, fig, see *Mesembryanthemum*
- *Matthiola* (ten-weeks' stock)
  - 141. *Aphis pseudobrassicae* Davis
- Mayten, see *Maytenus*
- *Maytenus* (mayten)
  - 121. *Aphis euonomi* Fabr.

- *Medicago* (alfalfa, bur clover, etc.)
  - 131. *Aphis medicaginis* Koch
  - 74. *Macrosiphum pisi* (Kalt.)
- *Melianthus* (honey flower)
  - 104. *Rhopalosiphum persicae* (Sulz.)
- *Melilotus* (sweet clover)
  - 131. *Aphis medicaginis* Koch
- *Mesembryanthemum* (fig marigold)
  - 121. *Aphis euonomi* Fabr.
- Milk thistle, see *Silybum*
- Milkweed, see *Asclepias*
- Morning glory, see *Convolvulus*
- *Morus* (mulberry)
  - 133. *Aphis mori* Clarke
- Mountain holly, see *Heteromeles*
- Mountain lilac, see *Ceanothus*
- Mugwort, California, see *Artemisia*
- Mulberry, see *Morus*
- *Musa* (banana)
  - 111. *Aphis avenae* Fabr.
- Muskmelon, see *Cucumis*
- Mustard, see *Brassica*
- Mustard, Hedge, see *Sisymbrium*
- Mustard, Teasel, see *Erysimum*
- Nasturtium, see *Tropaeolum*
- Nectarine, see *Prunus*
- *Nephrolepis* (Boston fern)
  - 58. *Idiopterus nephrelepidis* Davis
- *Nerium* (oleander)
  - 135. *Aphis nerii* Fonsc.
- Nettle, Hedge, see *Stachys*
- Nettle, Stinging, see *Urtica*
- Nightshade, see *Solanum*
- Ninebark, see *Physocarpus*
- *Nymphaea* (water lily)
  - 123. *Aphis gossypii* Glover
  - 156. *Siphocoryne nymphaeae* (Linn.)
- Oak, see *Quercus*
- Oak, Poison, see *Rhus*
- Oak, Tanbark, see *Pasania*
- Oats, see *Avena*
- *Oenothera* (evening primrose)
  - 136. *Aphis oenotherae* Oestlund
- Oldman, see *Artemisia*
- Oleander, see *Nerium*
- Orange, see *Citrus*
- Orache, see *Atriplex*
- *Orchidaceae* (orchids)
  - 162. *Cerataphis lataniae* (Boisd.)
- *Orthocarpus* (owl clover)
  - 73. *Macrosiphum orthocarpi* Davidson
- Owl clover, see *Orthocarpus*

Oxalis (oxalis)
    97. *Macrosiphum solanifolii* (Ashmead)
    104. *Rhopalosiphum persicae* (Sulz.)
    152. *Toxoptera aurantii* (Fonsc.)
Pansy, see *Viola*
Papaver (poppy)
    121. *Aphis euonomi* Fabr. (*papaveris* Fabr.?)
Parsley, see *Petrosclinum*
Parsnip, see *Pastinaca*
Parsnip, Cow, see *Heracleum*
Pasania (tanbark oak)
    20. *Myzocallis pasaniae* Davidson
Pastinaca (parsnip)
    156. *Siphocoryne pastinacae* (Linn.)
Pea, see *Pisum*
Pea, Cow, see *Vigna*
Pea, Sweet, see *Lathyrus*
Pea tree, see *Carugona*
Peach, see *Prunus*
Pear, see *Pyrus*
Pelargonium (geranium)
    97. *Pentalonia nigronervosa* Coquellet
    104. *Rhopalosiphum persicae* (Sulz.)
Pentstemon (pentstemon)
    88. *Myzus circumflexus* (Buckton)
    104. *Rhopalosiphum persicae* (Sulz.)
Pepper, see *Capsicum*
Peppergrass, see *Lepidium*
Periwinkle, see *Vinca*
Persea (avacado)
    123. *Aphis gossypii* Glover
Petroselinum (parsley)
    155. *Siphocoryne capreae* (Fabr.)
Phalaris (canary grass)
    111. *Aphis avenae* Fabr.
    153. *Hyalopterus arundinis* (Fabr.)
Phaseolus (bean)
    121. *Aphis euonomi* Fabr. (*rumicis* Linn.?)
    131. *Aphis medicaginis* Koch
    74. *Macrosiphum pisi* (Kalt.)
Phragmites (reed grass)
    153. *Hyalopterus arundinis* (Fabr.)
Phyllostachys (bamboo)
    12. *Myzocallis arundicolens* (Clarke)
Physocarpus (ninebark)
    100. *Rhopalosiphum corylinum* Davidson
Picea (spruce)
    46. *Lachnus glehnus* Essig
    55. *Lachnus vanduzei* n.sp.
    158. *Myzaphis abietina* (Walker)
Pigweed, see *Amaranthus*, and *Chenopodium*
Pimento, see *Capsicum*

- ***Pimpinella***
  - 155. *Siphocoryne capreae* (Fabr.)
- Pine, see ***Pinus***
- ***Pinus*** (pine)
  - 178. *Chermes cooleyi* Gillette
  - 179. *Chermes pinicorticis* Fitch
  - 43. *Essigella californica* (Essig)
  - 45. *Lachnus ferrisi* Swain
  - 48. *Lachnus oregonensis* Wilson
  - 49. *Lachnus pini-radiatae* Davidson
  - 50. *Lachnus ponderosa* Williams
  - 52. *Lachnus sabinianus* n.sp.
  - 53a. *Lachnus tomentosa* (De Geer) (Addenda)
  - 176. *Mindarus abietinus* Koch
- *Pisum* (pea)
  - 74. *Macrosiphum pisi* (Kalt.)
- *Pittosporum* (pittosporum)
  - 139. *Aphis pomi* De Geer
  - 79. *Macrosiphum solanifolii* (Ashmead)
  - 104. *Rhopalosiphum persicae* (Sulz.)
- *Plantago* (plantain)
  - 123. *Aphis gossypii* Glover
  - 129. *Aphis malifoliae* Fitch (?)
  - 88. *Myzus circumflexus* (Buckton)
- Plantain see *Plantago*
- Plantain, Water, see *Alisma*
- *Platanus* (western sycamore)
  - 4. *Drepanosiphum platanoides* (Schrank)
- Plum, see *Prunus*
- *Polygonum* (knotweed)
  - 100. *Rhopalosiphum hippophaes* (Koch).
  - 156. *Siphocoryne nymphaeae* (Linn.)
- Pomegranate, see *Punica*
- Pondweed, see *Potamogeton*
- Poplar, see *Populus*
- Poppy, see *Papaver*
- Poppy, California, see *Eschscholtzia*
- *Populus* (poplar, cottonwood)
  - 28. *Arctaphis populifolii* (Essig)
  - 164. *Pemphigus betae* Doane
  - 165. *Pemphigus populi-caulis* Fitch
  - 166. *Pemphigus populi-transversus* Riley
  - 181. *Phylloxerina popularia* (Pergande)
  - 40. *Pterocomma populifoliae* (Fitch)
  - 167. *Thecabius californicus* (Davidson)
  - 168. *Thecabius populiconduplifolius* (Cowen)
  - 169. *Thecabius populi-monilis* (Riley)
  - 34. *Thomasia populicola* (Thomas)
  - 35. *Thomasia salicola* (Essig)
- *Potamogeton* (pondweed)
  - 156. *Siphocoryne nymphaeae* (Linn.)
- Potato, see ***Solarum***

- Primrose, Evening, see *Oenothera*
- *Primula* (cowslip)
    - 56. *Amphorophora latysiphon* Davidson
- Prune, see *Prunus*
- *Prunus* (almond, apricot, cherry, nectarine, peach, plum, prune)
    - 107. *Aphis alamedensis* Clarke
    - 114. *Aphis cardui* Linn.
    - 117. *Aphis cerasifoliae* Fitch
    - 138. *Aphis persicae-niger* Smith
    - 140. *Aphis prunorum* Dobr.
    - 153. *Hyalopterus arundinis* (Fabr.
    - 87. *Myzus cerasi* (Fabr.)
    - 98. *Phorodon humuli* (Schrank)
    - 104. *Rhopalosiphum persicae* (Sulz.)
    - 156. *Siphocoryne nymphaeae* (Linn.)
- *Pseudotsuga* (Douglas fir)
    - 178. *Chermes cooleyi* Gillette
    - 43. *Essigella californica* (Essig)
    - 51. *Lachnus pseudotsuga* Wilson
    - 53. *Lachnus taxifolia* Swain
    - 171. *Prociphilus venafuscus* Patch
- *Psorales* (leather root)
    - 74. *Macrosiphum pisi* (Kalt.)
- *Pteris* (brake)
    - 75. *Macrosiphum pteridis* Wilson
- *Punica* (pomegranate)
    - 123. *Aphis gossypii* Glover
- Pumpkin, see *Cucurbita*
- *Pyrus* (apple, pear)
    - 123. *Aphis gossypii* Glover
    - 129. *Aphis malifoliae* Fitch
    - 139. *Aphis pomi* De Geer
    - 175. *Eriosoma languinosa* Hartig (*pyricola* B. & D.)
    - 174. *Eriosoma lanigerum* (Hausman)
- *Quercus* (oak)
    - 5. *Drepanaphis acerifolii* (Fitch) (?)
    - 14. *Myzocallis bellus* (Walsh)
    - 15. *Myzocallis castanicola* Baker (*davidsoni* Swain)
    - 17. *Myzocallis discolor* (Monell)
    - 18. *Myzocallis punctatus* (Monell)
    - 19. *Myzocallis californicus* Baker (*maureri* Swain)
    - 21. *Myzocallis quercus* (Kalt.)
    - 3. *Phyllaphis quercicola* Baker
    - 36. *Symydobius agrifoliae* Essig
    - 37. *Symydobius chrysolepis* Swain
    - 177. *Vacuna dryophila* Schrank (?)
- Quince, see *Cydonia*
- Radish, see *Raphanus*
- Ragweed, see *Ambrosia*
- *Ramona* (black sage)
    - 142. *Aphis ramona* Swain

- *Ranunculus* (buttercup)
  - 132. *Aphis middletonii* Thomas
  - 104. *Rhopalosiphum persicae* (Sulz.)
  - 167. *Thecabius californicus* (Davidson)
  - 168. *Thecabius populiconduplifolius* (Cowen)
- *Raphanus* (radish)
  - 112. *Aphis brassicae* Linn.
  - 141. *Aphis pseudobrassicae* Davis
  - 104. *Rhopalosiphum persicae* (Sulz.)
- Reed, Giant, see *Arundo*
- Reed grass, see *Phragmites*
- *Rhamnus* (buckthorn, coffeeberry)
  - 123. *Aphis gossypii* Glover
  - 92. *Myzus rhamnus* (Clarke)
- *Rhus* (poison oak)
  - 105. *Rhopalosiphum rhois* Monell
- *Ribes* (currant, gooseberry)
  - 126. *Aphis houghtonensis* Troop
  - 134. *Aphis neo-mexicana* Ckll. var. *pacifica* Dvdn.
  - 89. *Myzus cynosbati* (Oestlund)
  - 93. *Myzus ribifolii* Davidson
- *Robinia* (locust)
  - 131. *Aphis medicaginis* Koch
- *Rosa* (rose, wild and cultivated)
  - 67. *Macrosiphum dirhodum* (Walker)
  - 76. *Macrosiphum rosae* (Linn.)
  - 159. *Myzaphis rosarum* (Walker)
  - 103. *Myzus nervatum* Gillette
- Rose, see *Rosa*
- Rose mallow, see *Hibiscus*
- *Rubus* (blackberry, loganberry, thimbleberry)
  - 143. *Aphis rubiphila* Patch
  - 57. *Amphorophora rubi* (Kalt.)
  - 95. *Nectarosiphon rubicola* (Oestlund)
- *Rumex* (dock, sorrell)
  - 121. *Aphis euonomi* Fabr. (*rumicis* Linn.)
  - 123. *Aphis gossypii* Glover
  - 146. *Aphis senecio* Swain
  - 164. *Pemphigus betae* Doane (?)
  - 104. *Rhopalosiphum persicae* (Sulz.)
- Rye, Wild, see *Elymus*
- Sagebrush, see *Artemisia*
- Sage, Black, see *Ramona*
- *Salix* (willow)
  - 144. *Aphis salicicola* Thomas
  - 146. *Aphis senecio* Swain
  - 29. *Arctaphis viminalis* (Monell)
  - 31. *Fullawaya saliciradicis* Essig
  - 64. *Macrosiphum californicum* (Clarke)
  - 30. *Micrella monella* Essig
  - 182. *Phylloxerina salicola* (Pergande)
  - 40. *Pterocomma flocculosa* (Weed)

    41. *Pterocomma populifoliae* (Fitch)
    42. *Pterocomma smithiae* (Monell)
    155. *Siphocoryne capreae* (Fabr.)
    38. *Symydobius macrostachyae* Essig
    39. *Symydobius salicicorticis* Essig
    32. *Thomasia crucis* Essig
    34. *Thomasia populicola* (Thomas)
    35. *Thomasia salicola* (Essig)
    44. *Tuberolachnus viminalis* (Fonsc.)
Sambucus (elderberry)
    145. *Aphis sambucifoliae* Fitch
    81. *Macrosiphum stanleyi* Wilson
    104. *Rhopalosiphum persicae* (Sulz.)
Sanicula (gambleweed)
    119. *Aphis cornifoliae* Fitch
    104. *Rhopalosiphum persicae* (Sulz.)
Scrophularia (figwort)
    99. *Phorodon scrophulariae* Thamos
Senecio (German ivy, ivy senecio)
    144. *Aphis senecio* Swain
    88. *Myzus circumflexus* (Buckton)
    104. *Rhopalosiphum persicae* (Sulz.)
Shepherd's-purse, see *Capsella*
Silybum (milk thistle)
    121. *Aphis euonomi* Fabr.
    130. *Aphis marutae* Oestlund
Sisymbrium (hedge mustard)
    88. *Myzus circumflexus* (Buckton)
Smilax, see *Asparagus*
Snowball, see *Viburnum*
Snowberry, see *Symphoricarpos*
Solanum (potato, nightshade)
    56. *Amphorophora latysiphon* Davidson
    79. *Macrosiphum solanifolii* (Ashmead)
    88. *Myzus circumflexus* (Buckton)
    102. *Rhopalosiphum lactucae* (Kalt.)
    104. *Rhopalosiphum persicae* (Sulz.)
    163. *Trifidaphis radicicola* (Essig)
Sonchus (sow thistle)
    79. *Macrosiphum solanifolii* (Ashmead)
    80. *Macrosiphum sonchella* (Monell)
    102. *Rhopalosiphum lactucae* (Kalt.)
    104. *Rhopalosiphum persicae* (Sulz.)
Sorghum
    129. *Aphis maidis* Fitch
Sorrell, see *Rumex*
Sow thistle see *Sonchus*
Spinacia (spinach)
    123. *Aphis gossypii* Glover
    104. *Rhopalosiphum persicae* (Sulz.)
Spirea (spirea)
    148. *Aphis spiraecola* Patch

Spruce, see *Picea*
Squash, see *Cucurbita*
Stachys (hedge nettle)
    73. *Macrosiphum ludovicianae* (Oestlund)
    88. *Myzus circumflexus* (Buckton)
Stock, Ten-week, see *Matthiola*
Strawberry, see *Fragaria*
Strawberry tree, see *Arbutus*
Sugar beet, see *Beta*
Sunflower, see *Helianthus*
Sweet clover, see *Melilotus*
Sweet pea, see *Lathyrus*
Sycamore, Western, see *Platanus*
Symphoricarpos (snowberry)
    108. *Aphis albipes* Oestlund
Syringa (lilac)
    131. *Aphis medicaginis* Koch
Tacalote, see *Centaurea*
Taraxacum (dandelion)
    82. *Macrosiphum taraxici* (Kalt.)
Tarweed, see *Madia* and *Hemizonia*
Teasel, Fuller's, see *Dipsacus*
Teasel, mustard, see *Erysimum*
Thimbleberry, see *Rubus*
Thistle, see *Cirsium*
Thistle, Milk, see *Silybum*
Thistle, Sow, see *Sonchus*
Thuja (arbor vitae)
    54. *Lachnus tujafilinus* (Del Guercio)
Tilia (linden, basswood)
    10. *Eucallipterus tiliae* (Linn.)
Tomato, see *Lycopersicum*
Trifolium (clover)
    146a. *Aphis bakeri* Cowen
    131. *Aphis medicaginis* Koch
Trigonella (fenugreek)
    69. *Macrosiphum pisi* (Kalt.)
Triticum (wheat)
    111. *Aphis avenae* Fabr.
    64. *Macrosiphum granarium* (Kirby)
Tropaeolum (nasturtium)
    121. *Aphis euonomi* Fabr.
    88. *Myzus circumflexus* (Buckton)
    104. *Rhopalosiphum persicae* (Sulz.)
Tule, California, see *Typha*
Tulip, see *Tulipa*
Tulip tree, see *Liriodendron*
Tulipa (tulip)
    83. *Macrosiphum tulipae* (Monell)
    104. *Rhopalosiphum persicae* (Sulz.)
Turnip, see *Brassica*

Typha (California tule)
111. *Aphis avenae* Fabr.
153. *Hyalopterus arundinis* (Fabr.)
68. *Macrosiphum granarium* (Kirby)
156. *Siphocoryne nymphaeae* (Linn.)

Ulmus (elm)
28. *Arctaphis populifolii* (Essig) (?)
172. *Colopha ulmicola* (Fitch)
173. *Eriosoma americana* (Riley)
175. *Eriosoma languinosa* Hartig (*pyricola* B. & D.)
174. *Eriosoma lanigerum* (Hausman)
79. *Macrosiphum solanifolii* (Ashmead)
22. *Myzocallis ulmifolii* (Monell)

Umbellularia (California laurel)
88. *Myzus circumflexus* (Buckton)
104. *Rhopalosiphum persicae* (Sulz.)
157. *Siphocoryne pastinacae* (Linn.)

Urtica (stinging nettle)
121. *Aphis euonomi* Fabr.

Valerian, Red, see *Centranthus*

Valeriana
84. *Macrosiphum valerianae* (Clarke)

Vernonia (ironweed)
123. *Aphis gossypii* Glover

Vetch, see *Vicia*

Viburnum (lauristinus, snowball)
121. *Aphis euonomi* Fabr.
139. *Aphis pomi* De Geer
150. *Aphis viburnicolens* n.sp.

Vicia (horse bean, vetch)
121. *Aphis euonomi* Fabr. (*fabae* Scop.)
131. *Aphis medicaginis* Koch
74. *Macrosiphum pisi* (Kalt.)

Vigna (blackeye bean, cowpea)
131. *Aphis medicaginis* Koch

Vineca (periwinkle)
56. *Amphorophora latysiphon* Davidson
88. *Myzus circumflexus* (Buckton)
104. *Rhopalosiphum persicae* (Sulz.)

Viola (pansy, violet)
58. *Idiopterus nephrelepidis* Davis
74. *Macrosiphum pisi* (Kalt.)
88. *Myzus circumflexus* (Buckton)
106. *Rhopalosiphum violae* Pergande

Vitis (grape)
180. *Phylloxera vitifoliae* (Fitch)

Wallflower, see *Cheiranthus*

Wallflower, Western, see *Erysimum*

Walnut, see *Juglans*

Water hemlock, see *Cicuta*

Watermelon, see *Citrullus*

Water plantain, see *Alisma*

Wheat, see *Triticum*
Willow, see *Salix*
Yarrow, see *Achillea*
Yucca (yucca)
    151. *Aphis yuccae* Cowen
Zantedeschia (calla)
    88. *Myzus circumflexus* (Buckton)
Zea (corn)
    111. *Aphis avenae* Fabr.
    128. *Aphis maidis* Fitch
Zizia
    155. *Siphocoryne capreae* (Fabr.)

ADDENDA

Since the preparation of this manuscript there have appeared a few papers[36] in which there are some new records for certain of the California Aphididae and in which there are notes concerning the synonymy of some of the species. These records are noted here and are listed in the Host Plant Index (appendix 2).

2. **Phyllaphis fagi** (Linn.) on Fagus tricolor, Oakland (Essig, p. 321).

7. **Euceraphis betulae** (Koch) on *Betula populifolia laciniata* and *B. papyrifera* (Essig, pp. 322–323).

10. **Eucallipterus tiliae** (Linn.) on *Tilia tomentosa*, Berkeley (Essig, p. 323). Baker places this species in the genus *Myzocallis*, for although it is quite distinct from the type of *Myzocallis*, various species form definite connections leading to this one.

15. **Myzocallis castanicola** Baker (Baker, p. 424). This name has been suggested by Baker to replace *M. castaneae* (Buckton) (preoccupied by *castaneae* (Fitch)). Therefore the name suggested by the author, *M. davidsoni* Swain, must be dropped. Essig (p. 323) lists *M. castaneae* (Fitch), but he refers to this species.

19. **Myzocallis californicus** Baker (Baker, pp. 421–422). This is the same species as described by the author under the name, *Myzocallis maureri* Swain, which name will have to be dropped, and replaced by *M. californicus* Baker.

53a. **Lachnus tomentosus** (De Geer), on *Pinus radiata*, Berkeley (Gillette, pp. 140-141). This species is very similar to *L. pini-radiatae* Davidson, according to Gillette. The author finds on looking over his specimens that some of them labeled *L. pini radiatae* Dvdn. are this species, particularly those taken on the campus at Berkeley.

56. **Amphorophora latysiphon** Davidson, on *Chrysanthemum* and *Primula* sp., Berkeley (Essig, p. 329).

68. **Macrosiphum granarium** (Kirby), on *Alopecurus pratensis*, *Ampelodesma tenax*, and *Elymus* sp., Martinez (Essig, p. 328).

76. **Macrosiphum rosae** (Linn.) on *Dipsacus fullonum* and *Centranthus ruber*, Berkeley (Essig, p. 329).

79. **Macrosiphum solanifolii** (Ashmead), on *Achillea millefolium* and *Pittosporum tobira*, Berkeley, and on *Ulmus americanus*, San Francisco (Essig, p. 329).

88. **Myzus circumflexus** (Buckton), on *Lilium* spp., *Pentstemon spectabilis*, and *Umbellularia californica*, Berkeley (Essig, p. 335).

102. **Rhopalosiphum lactucae** (Kalt.). Dobrovliansky lists this as a synonym of *R. ribis* (Buckton), giving the latter name preference.

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[36] Baker, A. C., Eastern aphids, new and little known, II, Jour. Econ. Ent., vol. 10, pp. 421–433, 1917.

Baker, A. C., The correct name for our apple-grain aphis, Science, vol. 46, pp. 410–411, 1917.

Davidson, W. M., The reddish-brown plum aphis, Jour. Econ. Ent., vol. 10, pp. 350–353, 1917.

Dobrovliansky, V. V., A list of aphids found on cultivated plants in the government of Kharkov, *in* Pests of Agriculture, Kharkov, Bull. 1916; reviewed *in* Rev. Appl. Ent., vol. 5, pp. 561–562, 1917.

Essig, E. O., Aphididae of California, Univ. Calif. Publ. Entom., vol. 1, pp. 301–346, 1917.

Gillette, C. P., Some Colorado species of the genus *Lachnus*, Ent. Soc. Am., vol. 10, pp. 133–146, 1917.

Van der Goot, P., Zur Kenntnis der Blattläuse Java's, *in* Contrib. a là fauna der Indes neerlandaises, vol. 1, pp. 1–301, 1916.

104. **Rhopalosiphum persicae** (Sulzer), on *Baccharis douglasii, Centranthus ruber, Clarkia elegans, Dipsacus fullonum, Escallonia pulverulenta, Helianthus annuus, Lavatera assurgentiflora, Liriodendron tulipifera, Melianthus major, Pentstemon spectabilis, Pittosporum* spp., and *Umbellularia californica,* Berkeley (Essig, pp. 331–332).

111. **Aphis avenae** Fabr. It would appear from a study of Baker's paper in *Science* that the common California species is *Aphis prunifoliae* Fitch. It is certain that it is distinct from *A. cerasifoliae* Fitch, which has been taken here once and is described in this paper. If it is possible, as Baker says, that *A. cerasifoliae* Fitch is a synonym of *A. padi* Linn., then our common species must be known as *A. prunifoliae* Fitch. From the brief description of *Aphis* (*Siphonaphis*) *padi* Linn. given by Van der Goot (pp. 71–72) it would appear that our species may be distinct, differing slightly in the comparative lengths of the cornicles and cauda. Consequently the author favors accepting the name, *Aphis prunifoliae* Fitch, for this species.

123. **Aphis gossypii** Glover, on *Asclepias speciosa, A. vestita, Lilium speciosum rubrum, Lonicera* sp., and *Rhamnus purshiana,* Berkeley and Oakland (Essig, pp. 338–339).

131. **Aphis medicaginis** Koch, on *Citrus* sp., Sacramento, and on *Vigna sinensis,* Moorpark (Essig, p. 340).

139. **Aphis pomi** De Geer, on *Cotoneaster franchetii, Pittosporum eugenioides,* and *Viburnum tinus,* Berkeley (Essig, p. 341). The author is inclined to believe this to be *Aphis viburnicolens* n.sp. (see no. 150) which is quite similar to *Aphis pomi* De Geer, but which is common on *Viburnum* and related plants. He has not, however, seen Essig's specimens, so can not state positively whether or not it is this species.

140. **Aphis prunorum** Dobr. Dobrovliansky places this species as a synonym of *Siphocoryne nymphaeae* (Linn.). This author noted the similarity of these two, but was not certain of their identity, so listed them as distinct species.

141. **Aphis pseudobrassicae** Davis. Dobrovliansky believes this to be a synonym of *Aphis erysimi* Kalt.

146. **Aphis senecio** Swain. Essig (p. 337) lists *Aphis bakeri* Cowen from *Trifolium pratense.* This proves to be the true *Aphis bakeri* Cowen and not *A. senecio* Swain, which is the species that has been hitherto called *A. bakeri* Cowen in California.

152. **Toxoptera aurantii** (Fonsc.) on *Camellia japonica,* Oakland (Essig, p. 330).

153. **Hyalopterus arundinis** (Fabr.). Both Dobrovliansky and Van der Goot list this as a synonym of *H. pruni* (Fabr.) giving the later preference. According to Hunter, *arundinis* should have priority, but it is entirely possible that the dates he gives are incorrect. This point the author is unable to settle as he has not access to Fabricius' works.

156. **Siphocoryne nymphaeae** (Linn.). Davidson gives a brief account of the habits and biology of this species, as well as a description of the various forms.

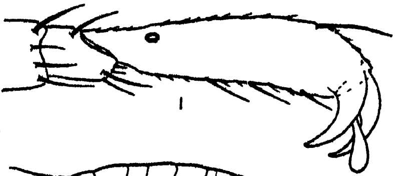
175. **Eriosoma lanuginosa** Hartig (*pyricola* Baker and Davidson). The species listed by Essig (p. 345) as *Eriosoma* sp. on *Ulmus campestris* in Berkeley and in Hayward is this species.

115. **Aphis cari** Essig. Davidson recently remarked to the author that he could see no difference between this species and *Aphis helianthii* Monell. It is quite possible that these are synonyms.

EXPLANATION OF PLATES

PLATE 1

Fig. 1. *Myzocallis asclepiadis* (Fitch), tarsus and claw.
Fig. 2. *Aphis senecio* Swain, tarsus and claw.
Fig. 3. *Essigella californica* (Essig), sixth antennal segment and spur.
Fig. 4. *Aphis senecio* Swain, sixth antennal segment and spur.
Fig. 5. *Essigella californica* (Essig), cauda and anal plate (lateral view).
Fig. 6. *Aphis senecio Swain,* cauda and anal plate (lateral view).
Fig. 7. *Eucallipterus tiliae* (Linn.), cauda and anal plate.
Fig. 8. *Thomasia populicola* (Thos.), cauda and anal plate.
Fig. 9. *Phyllaphis fagi* (Linn.), third antennal segment.
Fig. 10. *Phyllaphis fagi* (Linn.), sixth antennal segment.
Fig. 11. *Phyllaphis fagi* (Linn.), cauad and anal plate.
Fig. 12. *Phyllaphis fagi* (Linn.), front of head and antennal tubercles.
Fig. 13. *Phyllaphis coweni* (Ckll.), Antenna.
Fig. 14. *Phyllaphis quercicola* Baker, third antennal segment.
Fig. 15. *Phyllaphis quercicola* Baker, fourth antennal segment.
Fig. 16. *Phyllaphis quercicola* Baker, fifth antennal segment.
Fig. 17. *Phyllaphis quercicola* Baker, sixth antennal segment.
Fig. 18. *Phyllaphis quercicola* Baker, forewing.
Fig. 19. *Phyllaphis quercicola* Baker, cauda and anal plate.
Fig. 20. *Phyllaphis querci,* tarsal claw.
Fig. 21. *Drepanosiphum platanoides* (Schr.), antennal tubercles.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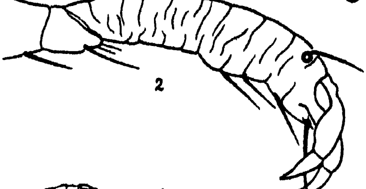
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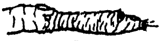
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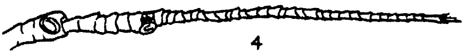
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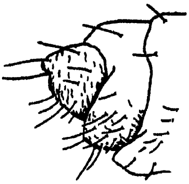
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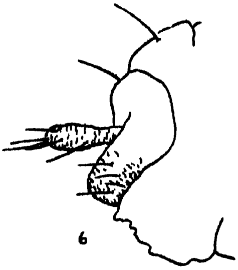
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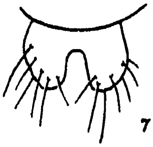
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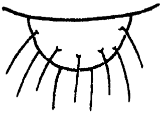
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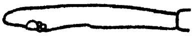
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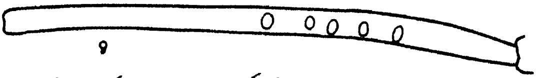
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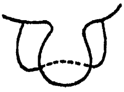
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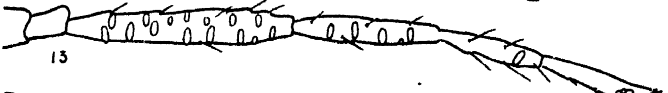
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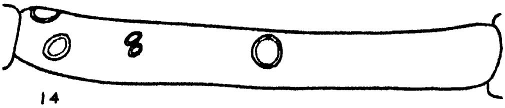
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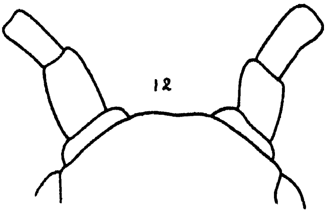
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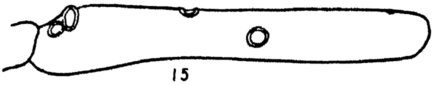
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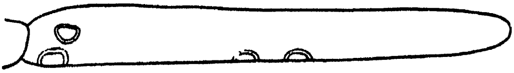
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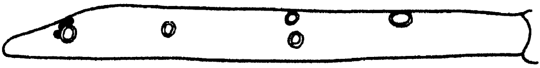
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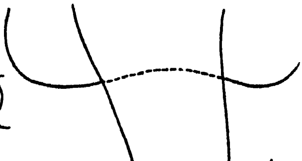
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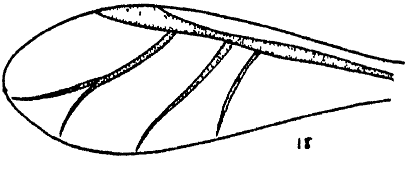
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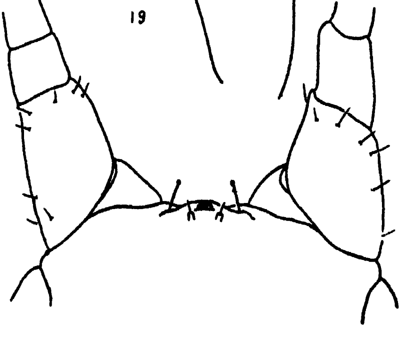
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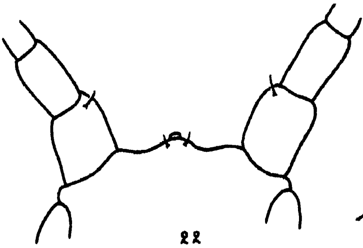
PLATE 2

Fig. 22. *Myzocallis arundicolens* (Clarke), antennal tubercles.
Fig. 23. *Drepanaphis acerifolii* (Thomas), cornicle.
Fig. 24. *Drepanosiphum platanoides* (Schr.), cornicle.
Fig. 25. *Monellia caryella* (Fitch), cornicle.
Fig. 26. *Myzocallis bellus* (Walsh), cornicle.
Fig. 27. *Calaphis betulaecolens* (Fitch), antennal tubercles.
Fig. 28. *Calaphis betulella* Walsh, antennal tubercles.
Fig. 29. *Euceraphis betulae* (Koch), antennal tubercles.
Fig. 30. *Eucallipterus tiliae* (Linn.), sixth antennal segment and spur.
Fig. 31. *Myzocallis quercus* (Kalt.), sixth antennal segment and spur.
Fig. 32. *Myzocallis quercus* (Kalt.), cornicle.
Fig. 33. *Eucallipterus tiliae* (Linn.), cornicle.
Fig. 34. *Chromaphis juglandicola* (Kalt.), sixth antennal segment and spur.
Fig. 35. *Chromaphis juglandicola* (Kalt.), cornicle.
Fig. 36. *Drepanosiphum platanoides* (Schr.), third antennal segment.
Fig. 37. *Drepanaphis acerifolii* (Thomas), third antennal segment.
Fig. 38. *Calaphis betulae-colens* (Fitch), third antennal segment.
Fig. 39. *Euceraphis gillettei* Dvdn., base of third antennal segment.
Fig. 40. *Euceraphis betulae* (Koch), base of third antennal segment.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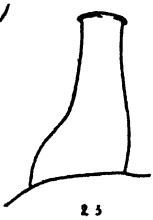
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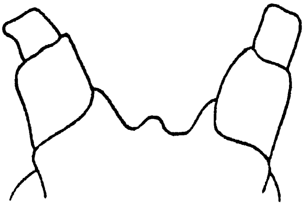
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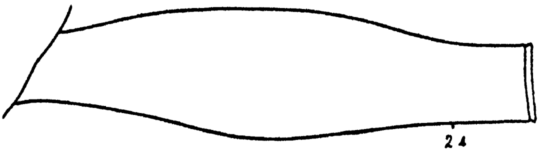
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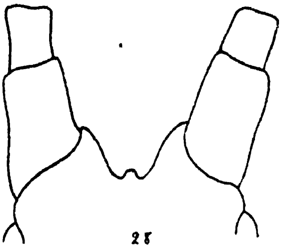
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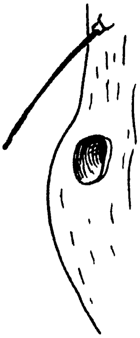
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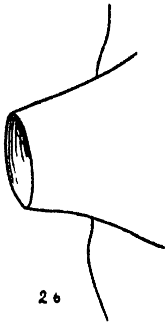
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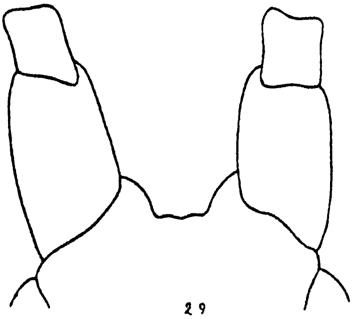
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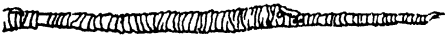
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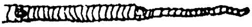
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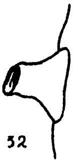
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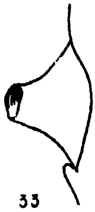
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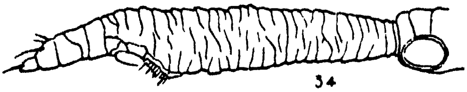
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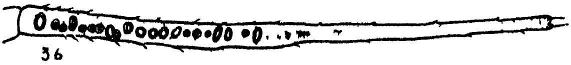
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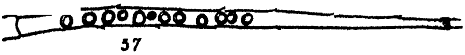
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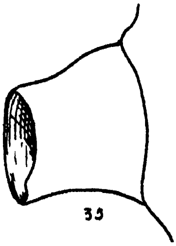
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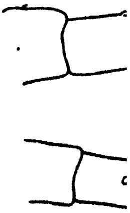


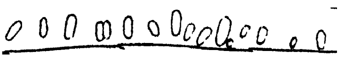
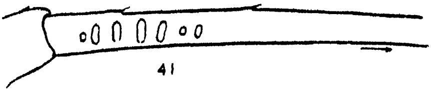


PLATE 3

Fig. 41. *Eucallipterus flava* (Dvdn.), base of third antennal segment.
Fig. 42. *Eucallipterus tiliae* (Linn.), third antennal segment.
Fig. 43. *Myzocallis coryli* (Goetze), third antennal segment.
Fig. 44. *Myzocallis coryli* (Goetze), sixth antennal segment and spur.
Fig. 45. *Myzocallis bellus* (Walsh), sixth antennal segment and spur.
Fig. 46. *Myzocallis bellus* (Walsh), third antennal segment.
Fig. 47. *Myzocallis alnifoliae* (Fitch), third antennal segment.
Fig. 48. *Myzocallis arundicolens* (Clarke), third antennal segment.
Fig. 49. *Eucallipterus tiliae* (Linn.), cornicle.
Fig. 50. *Eucallipterus tiliae* (Linn.), anal plate.
Fig. 51. *Myzocallis arundicolens* (Clarke), cornicle.
Fig. 52. *Myzocallis arundicolens* (Clarke), anal plate.
Fig. 53. *Myzocallis coryli* (Goetze), cornicle.
Fig. 54. *Myzocallis coryli* (Goetze), anal plate.
Fig. 55. *Myzocallis californicus* Baker, third antennal segment.
Fig. 56. *Myzocallis californicus* Baker, sixth antennal segment and spur.
Fig. 57. *Myzocallis pasaniae* Dvdn., third antennal segment.
Fig. 58. *Myzocallis quercus* (Kalt.), third antennal segment.
Fig. 59. *Myzocallis ulmifolii* (Monell), third antennal segment.
Fig. 60. *Myzocallis castanicola* Baker, third antennal segment.
Fig. 61. *Myzocallis castanicola* Baker, cauda and anal plate.
Fig. 62. *Myzocallis castanicola* Baker, cornicle.
Fig. 63. *Callipterus californicus* (Essig), sixth antennal segment and spur.
Fig. 64. *Callipterus californicus* (Essig), third antennal segment.
Fig. 65. *Callipterus caryae* Monell, third antennal segment.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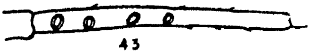
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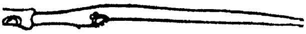
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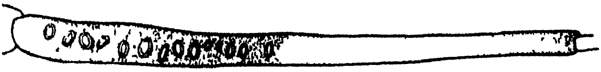
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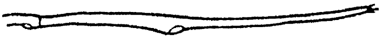
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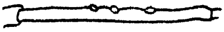
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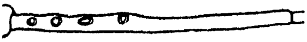
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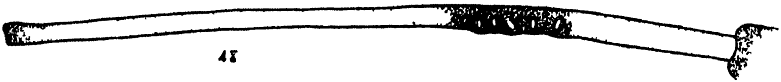
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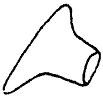
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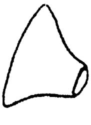
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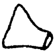
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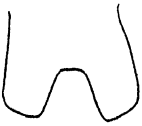
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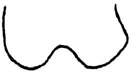
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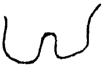
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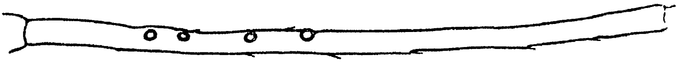
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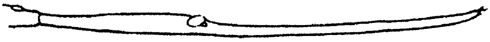
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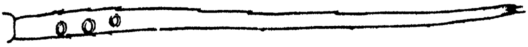
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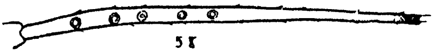
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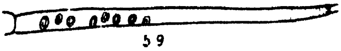
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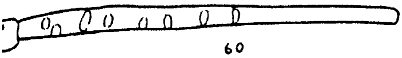
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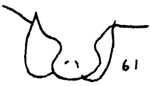
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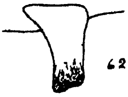
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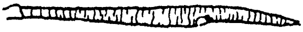
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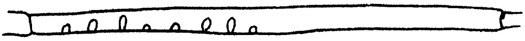
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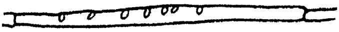
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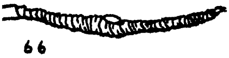
PLATE 4

Fig. 66. *Callipterus caryae* Monell, sixth antennal segment and spur.
Fig. 67. *Monellia caryella* (Fitch), sixth antennal segment and spur.
Fig. 68. *Monellia caryella* (Fitch), third antennal segment.
Fig. 69. *Arctaphis populifolii* (Essig), cauda.
Fig. 70. *Micrella monella* Essig, cauda.
Fig. 71. *Arctaphis populifolii* (Essig), third antennal segment.
Fig. 72. *Micrella monella* Essig, third antennal segment.
Fig. 73. *Symydobius macrostachyae* Essig, third antennal segment.
Fig. 74. *Symydobius salicicorticis* Essig, third antennal segment.
Fig. 75. *Fullawaya saliciradicis* Essig, third antennal segment.
Fig. 76. *Thomasia crucis* Essig, third antennal segment.
Fig. 77. *Thomasia populicola* (Thomas), third antennal segment.
Fig. 78. *Thomasia salicicola* (Essig), third antennal segment.
Fig. 79. *Lachnus ferrisi* Swain, tarsal claw.
Fig. 80. *Pterocomma populifoliae* (Fitch), tarsal claw.
Fig. 81. *Pterocomma flocculosa* (Weed), cornicle.
Fig. 82. *Pterocomma populifoliae* (Fitch), cornicle.
Fig. 83. *Essigella californica* (Essig), antenna.
Fig. 84. *Longistigma* sp., front wing.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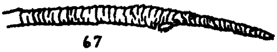
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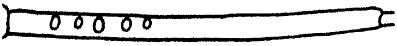
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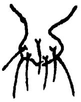
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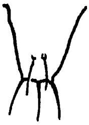
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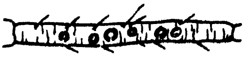
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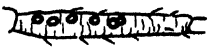
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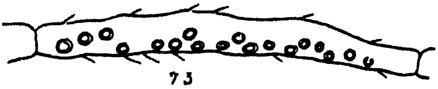
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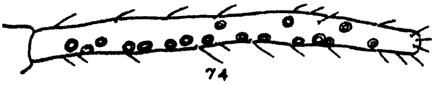
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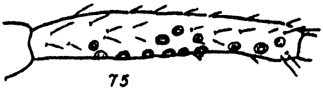
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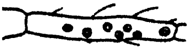
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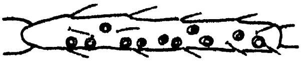
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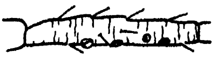
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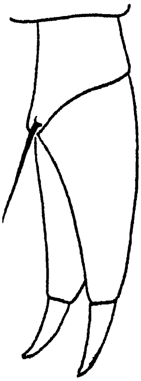
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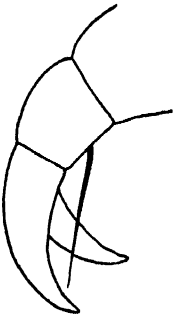
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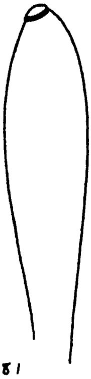
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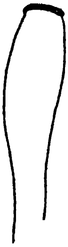
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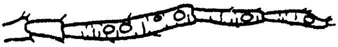
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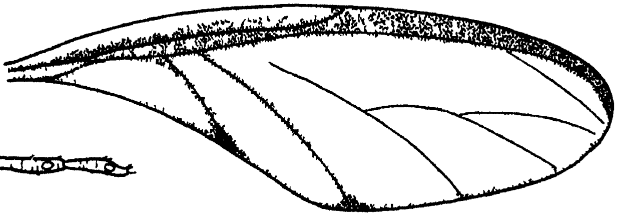
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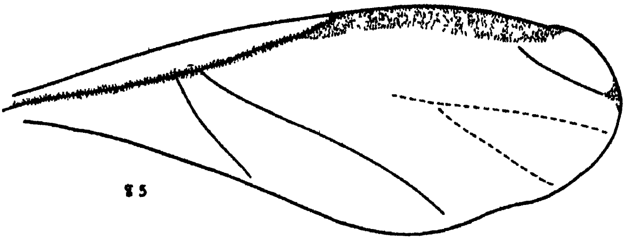
PLATE 5

Fig. 85. *Lachnus* sp., front wing.
Fig. 86. *Tuberolachnus viminalis* (Fonsc.), hind tarsus.
Fig. 87. *Eulachnus rileyi* Davis, hind tarsus.
Fig. 88. *Lachnus vanduzei* n.sp., third antennal segment.
Fig. 89. *Lachnus ferrisi* Swain, first, second, and third antennal segments.
Fig. 90. *Lachnus ferrisi* Swain, fourth, fifth, and sixth antennal segments.
Fig. 91. *Lachnus ferrisi* Swain, cornicle.
Fig. 92. *Lachnus pseudotsugae* Wilson, tip of front wing.
Fig. 93. *Lachnus tujafilinus* (Del Guercio), tip of front wing.
Fig. 94. *Lachnus occidentalis* Dvdn., third antennal segment.
Fig. 95. *Lachnus pini-radiatae* Dvdn. (?), third antennal segment.
Fig. 96. *Lachnus glehnus* Essig, third antennal segment.
Fig. 97. *Lachnus glehnus* Essig, cornicle.
Fig. 98. *Lachnus pseudotsugae* Wilson, third antennal segment.
Fig. 99. *Lachnus taxifolia* Swain, hind tarsus.
Fig. 100. *Lachnus taxifolia* Swain, fourth, fifth and sixth antennal segments.
Fig. 101. *Lachnus taxifolia* Swain, first, second, and third antennal segments.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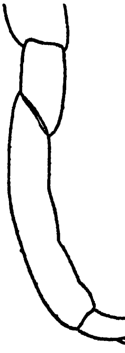
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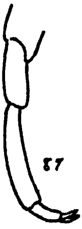
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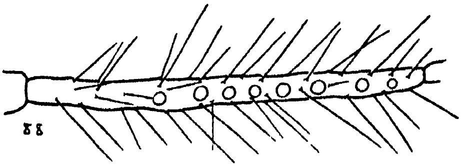
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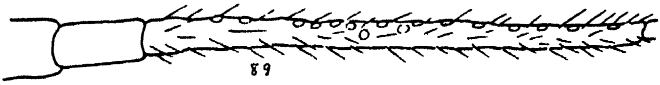
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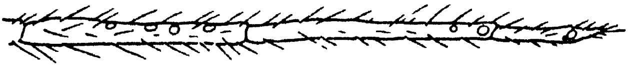
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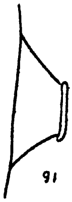
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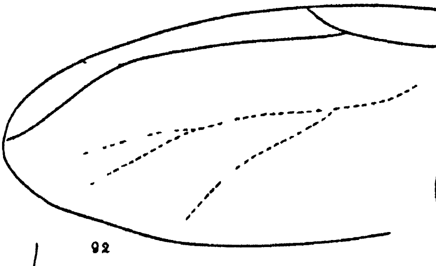
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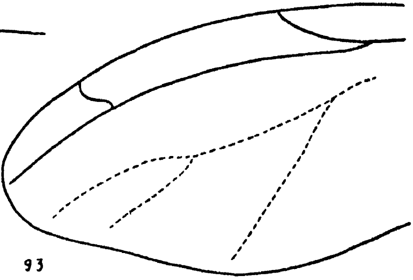
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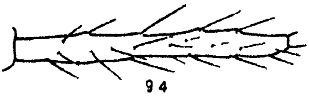
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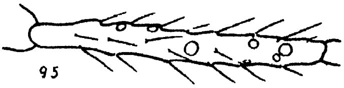
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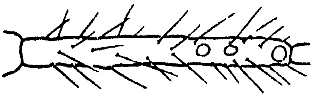
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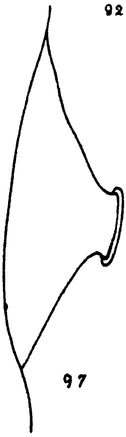
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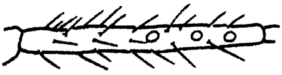
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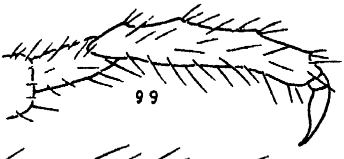
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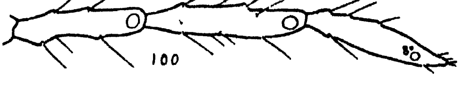
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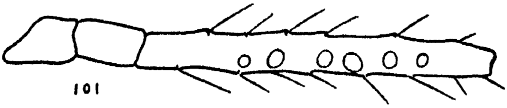
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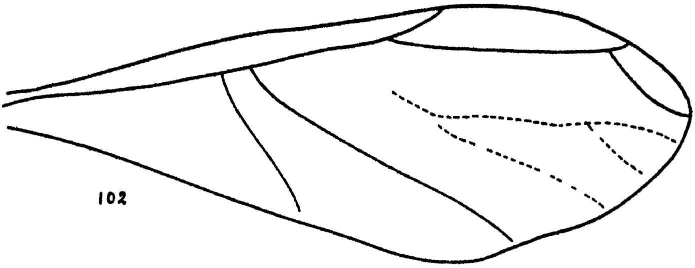
PLATE 6

Fig. 102. *Lachnus taxifolia* Swain, wing.
Fig. 103. *Lachnus taxifolia* Swain, cornicle of apterous female.
Fig. 104. *Lachnus ponderosa* Williams, third antennal segment.
Fig. 105. *Lachnus tujafilinus* (Del Guercio), third antennal segment.
Fig. 106. *Macrosiphum rosae* (Linn.), antennal tubercles.
Fig. 107. *Nectaro-siphon rubicola* (Oest.), antennal tubercles.
Fig. 108. *Rhopalosiphum persicae* (Sulz.), antennal tubercles.
Fig. 109. *Nectarosiphon rubicola* (Oest.), cornicle.
Fig. 110. *Idiopterus nephrelepidis* Davis, wing.
Fig. 111. *Amphorophora rubi* (Kalt.), antennal tubercles.
Fig. 112. *Myzus cerasi* (Fabr.), antennal tubercles.
Fig. 113. *Amphorophora rubi* (Kalt.), cornicle.
Fig. 114. *Toxoptera aurantii* (Fonsc.), cornicle.
Fig. 115. *Phorodon humuli* (Schr.), antennal tubercles of alate females.
Fig. 116. *Phorodon humuli* (Schr.), antennal tubercles of apterous females.



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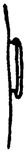

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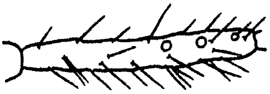

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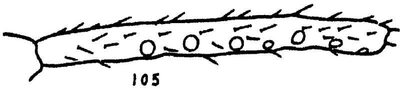

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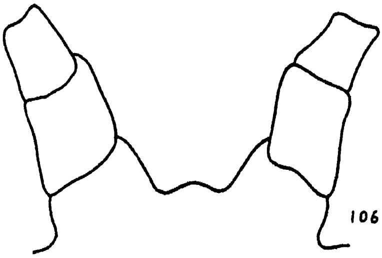

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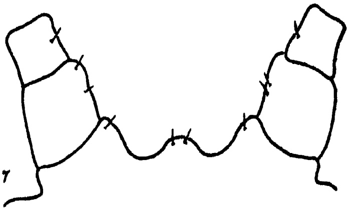

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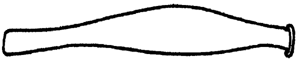

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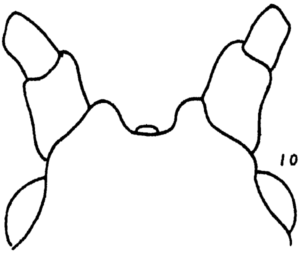

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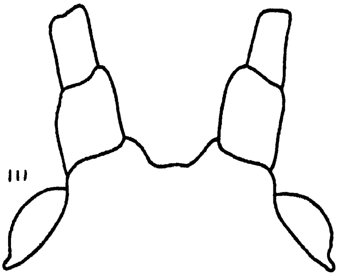

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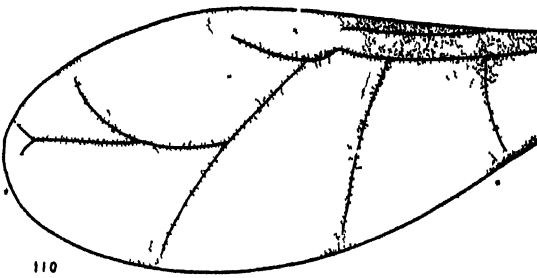

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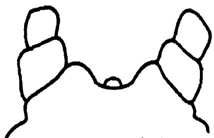

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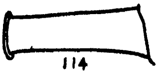

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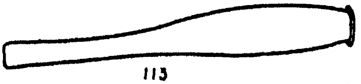

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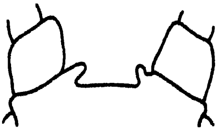

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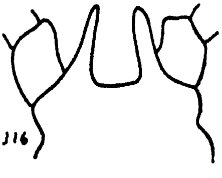

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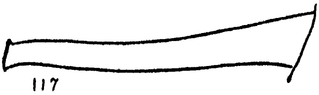
PLATE 7

Fig. 117. *Phorodon humuli* Schr., cornicle.
Fig. 118. *Phorodon humuli* Schr., cauda.
Fig. 119. *Rhopalosiphum persicae* (Sulz.), cornicle.
Fig. 120. *Rhopalosiphum pesicae* (Sulz.), cauda.
Fig. 121. *Myzus cerasi* (Fabr.), cornicle.
Fig. 122. *Myzus cerasi* (Fabr.), cauda.
Fig. 123. *Nectarosiphon rubicola* (Oest.), cauda.
Fig. 124. *Nectarosiphon morrisoni* Swain, antennal tubercles.
Fig. 125. *Nectarosiphon morrisoni* Swain, third antennal segment.
Fig. 126. *Nectarosiphon morrisoni* Swain, cauda.
Fig. 127. *Nectarosiphon morrisoni* Swain, cornicle.
Fig. 128. *Macrosiphum stanleyi* Wilson, cornicle.
Fig. 129. *Macrosiphum solanifolii* (Ashm.) (from *Sonchus*), cornicle.
Fig. 130. *Macrosiphum pisi* (Kalt.), cornicle.
Fig. 131. *Macrosiphum californicum* (Clarke), third antennal segment.
Fig. 132. *Macrosiphum californicum* (Clarke), cornicle.
Fig. 133. *Macrosiphum cucurbitae* (Thomas), third antennal segment.
Fig. 134. *Macrosiphum cucurbitae* (Thomas), cornicle.
Fig. 135. *Macrosiphum granarium* (Kirby), third antennal segment.
Fig. 136. *Macrosiphum ludovicianae* (Oest.), third antennal segment.
Fig. 137. *Macrosiphum solanifolii* (Ashm.), cornicle.
Fig. 138. *Macrosiphum solanifolii* (Ashm.), third antennal segment.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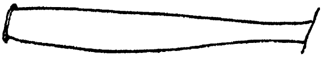
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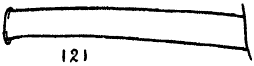
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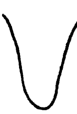
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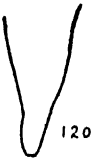
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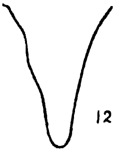
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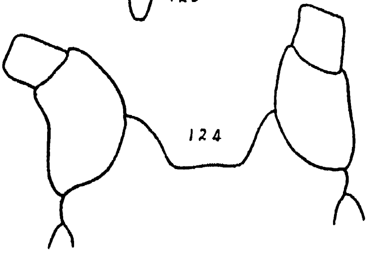
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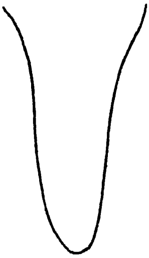
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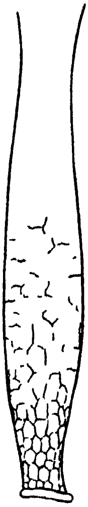
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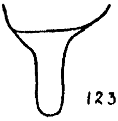
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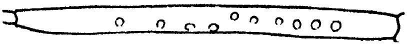
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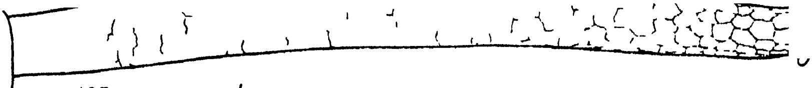
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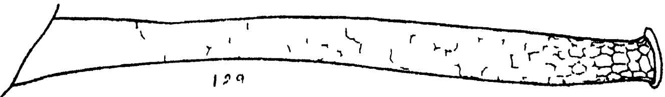
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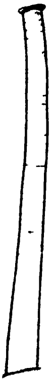
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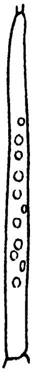
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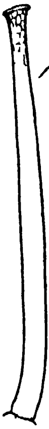
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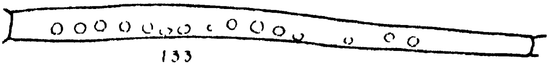
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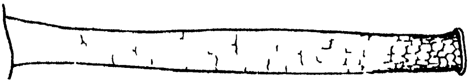
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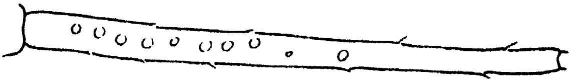
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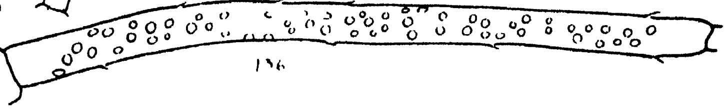
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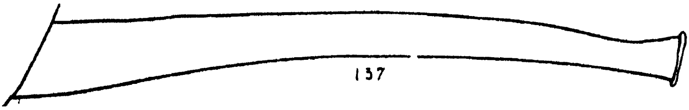
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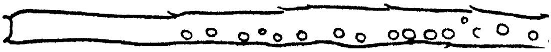
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PLATE 8

Fig. 139. *Macrosiphum solanifolii* (Ashm.) (from *Citrus*), cornicle.

Fig. 140. *Macrosiphum solanifolii* (Ashm.) (from *Citrus*), third antennal segment.

Fig. 141. *Macrosiphum sanborni* Gillette, cornicle of apterous female.

Fig. 142. *Macrosiphum artemisiae* (Fonsc.), cornicle.

Fig. 143. *Macrosiphum albifrons* Essig, third antennal segment.

Fig. 144. *Macrosiphum albifrons* Essig, cornicle.

Fig. 145. *Macrosiphum artemisiae* (Fonsc.), third antennal segment.

Fig. 146. *Macrosiphum artemisicola* (Williams), third antenal segment.

Fig. 147. *Macrosiphum artemisicola* (Williams), cornicle.

Fig. 148. *Macrosiphum granarium* (Kirby), cornicle.

Fig. 149. *Macrosiphum ludovicianae* (Oest.), cornicle.

Fig. 150. *Macrosiphum pisi* (Kalt.), third antennal segment.

Fig. 151. *Macrosiphum rosae* (Linn.), third antennal segment.

Fig. 152. *Macrosiphum rosae* (Linn.), cornicle.

Fig. 153. *Macrosiphum rudbeckiae* (Fitch), cornicle.

Fig. 154. *Macrosiphum rudbeckiae* (Fitch), third antennal segment.

Fig. 155. *Macrosiphum sanborni* Gillette, cauda apterous female.

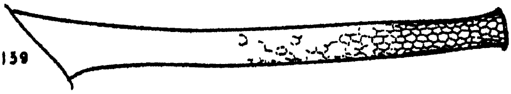
Fig. 156. *Macrosiphum dirhodum* (Walker), cornicle.

Fig. 157. *Macrosiphum dirhodum* (Walker), third antennal segment.

Fig. 158. *Macrosiphum stanleyi* Wilson, third antennal segment.

Fig. 159. *Macrosiphum solanifolii* (Ashm.) (from *Souchus*), third antennal segment.

Fig. 160. *Macrosiphum solanifolii* (Ashm.) (from *Sonchus*), cauda.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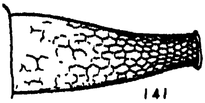
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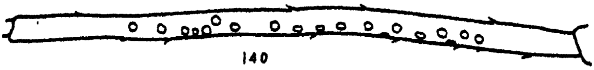
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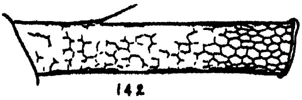
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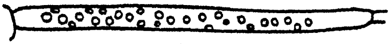
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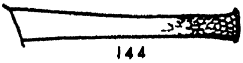
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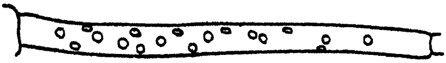
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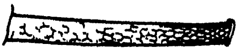
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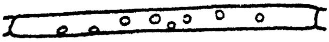
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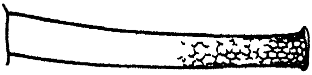
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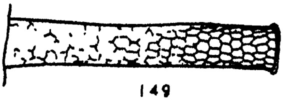
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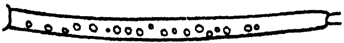
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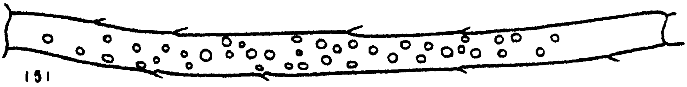
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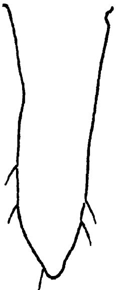
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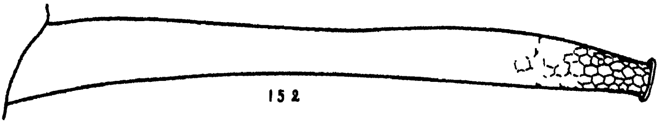
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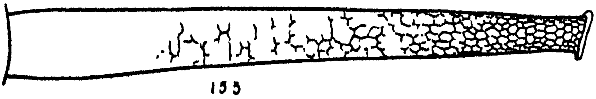
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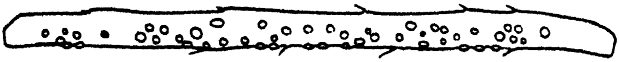
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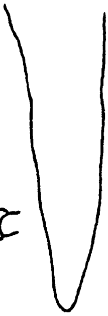
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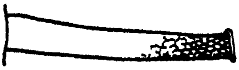
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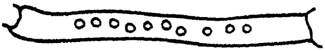
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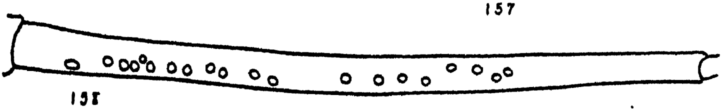
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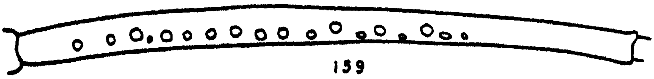
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PLATE 9

Fig. 161. *Amphorophora latysiphon* Dvdn., cornicle.

Fig. 162. *Amphorophora rubi* (Kalt.), cauda.

Fig. 163. *Toxoptera aurantii* (Fonsc.), third antennal segment.

Fig. 164. *Rhopalosiphum violae* Pergande, wing.

Fig. 165. *Rhopalosiphum hippophaes* Koch, cornicle.

Fig. 166. *Rhopalosiphum nervatum* Gillette (from *Arbutus*), wing.

Fig. 167. *Rhopalosiphum corylinum* Dvdn., third antennal segment.

Fig. 168. *Rhopalosiphum persicae* (Sulz.), third antennal segment.

Fig. 169. *Rhopalosiphum nervatum* Gillette (from *Arbutus*), third antennal segment.

Fig. 170. *Rhopalosiphum hippophaes* Koch, third antennal segment.

Fig. 171. *Rhopalosiphum nervatum* Gillette (from rose), third antennal segment.

Fig. 172. *Siphocoryne nymphaeae* (Linn.), third antennal segment.

Fig. 173. *Rhopalosiphum rhois* Monell, third antennal segment.

Fig. 174. *Rhopalosiphum violae* Pergande, third antennal segment.

Fig. 175. *Myzus circumflexus* (Buckton), third antennal segment.

Fig. 176. *Myzus braggii* Gillette, third antennal segment.

Fig. 177. *Myzus fragaefolii* Ckll., third antennal segment.

Fig. 178. *Myzus rhamni* (Fonsc.), third antennal segment.

Fig. 179. *Myzus cerasi* (Fabr.), third antennal segment.

Fig. 180. *Myzus ribis* (Linn.), third antennal segment.

Fig. 181. *Hyalopterus arundinis* (Fabr.), cornicle.

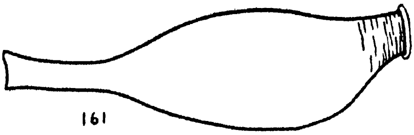
Fig. 182. *Aphis euonomi* Fabr., cornicle.

Fig. 183. *Siphocoryne capreae* (Fabr.), cornicle.

Fig. 184. *Liosomaphis berberidis* (Kalt.), cornicle.

Fig. 185. *Hyalopterus arundinis* (Fabr.), third and fourth antennal segments.

Fig. 186. *Hyalopterus arundinis* (Fabr.), cauda.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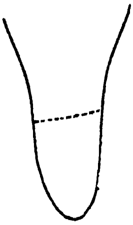
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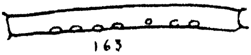
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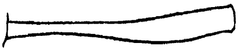
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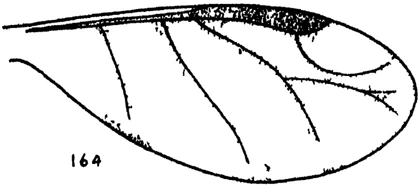
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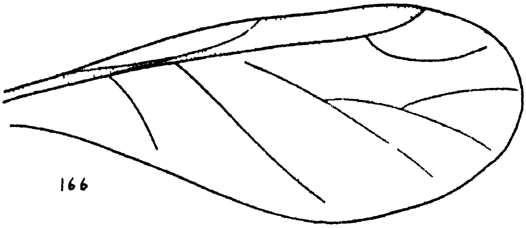
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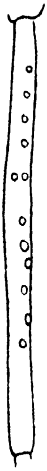
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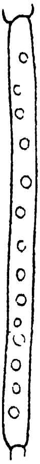
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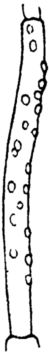
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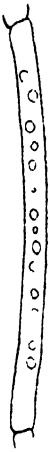
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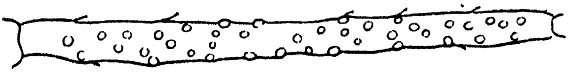
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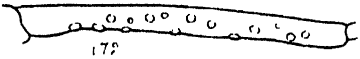
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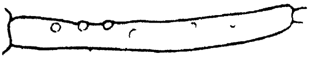
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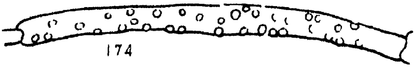
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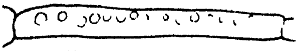
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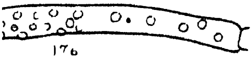
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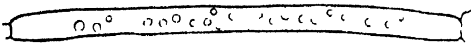

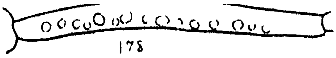
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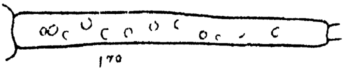
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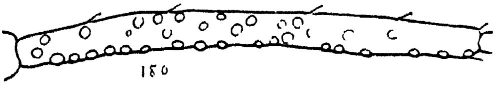
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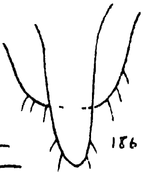
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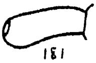
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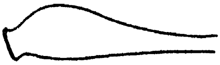
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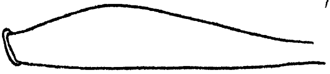
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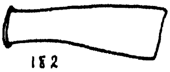
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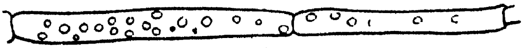
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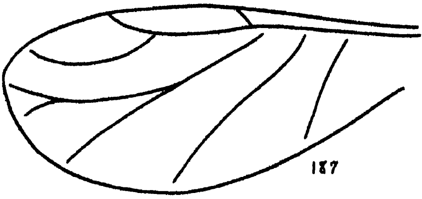
PLATE 10

Fig. 187. *Aphis euonomi* Fabr., wing.
Fig. 188. *Aphis salicicola* Thomas, wing.
Fig. 189. *Aphis medicaginis* Koch, third and fourth antennal segments.
Fig. 190. *Aphis euonomi* Fabr. (?), third and fourth antennal segments.
Fig. 191. *Aphis avenae* Fabr., wing.
Fig. 192. *Aphis gossypii* Glover, cornicle.
Fig. 193. *Aphis gossypii* Glover, cauda.
Fig. 194. *Aphis sambucifoliae* Fitch, cauda.
Fig. 195. *Aphis sambucifoliae* Fitch, cornicle.
Fig. 196. *Myzaphis abietina* (Walker), third and fourth antennal segments.
Fig. 197. *Myzaphis abietina* (Walker), cornicle.
Fig. 198. *Aphis albipes* Oest., cornicle.
Fig. 199. *Aphis albipes* Oest., cauda.
Fig. 200. *Aphis albipes* Oest., third and fourth antennal segments.
Fig. 201. *Aphis avenae* Fabr., cornicle.
Fig. 202. *Aphis avenae* Fabr., third and fourth antennal segments.
Fig. 203. *Aphis brassicae* Linn., cornicle.
Fig. 204. *Aphis brassicae* Linn., third and fourth antennal segments.
Fig. 205. *Aphis euonomi* Fabr., cornicle.
Fig. 206. *Aphis euonomi* Fabr., cornicle.
Fig. 207. *Aphis euonomi* Fabr., third and fourth antennal segments.
Fig. 208. *Aphis cardui* Linn., third and fourth antennal segments.
Fig. 209. *Aphis cardui* Linn., cornicle.
Fig. 210. *Aphis ceanothi* Clarke, cornicle.
Fig. 211. *Aphis ceanothi* Clarke, third and fourth antennal segments.
Fig. 212. *Aphis cookii* Essig, third and fourth antennal segments.
Fig. 213. *Aphis cookii* Essig, cauda and anal plate.
Fig. 214. *Aphis cookii* Essig, cornicle.
Fig. 215. *Aphis gossypii* Glover, third and fourth antennal segments.
Fig. 216. *Aphis maidis* Fitch, cauda.
Fig. 217. *Aphis maidis* Fitch, antenna.
Fig. 218. *Aphis maidis* Fitch, cornicle.
Fig. 219. *Aphis middletonii* Thomas, cornicle.
Fig. 220. *Aphis middletonii* Thomas, third and fourth antennal segments.
Fig. 221. *Aphis nerii* Fonsc., cornicle.
Fig. 222. *Aphis nerii* Fonsc., third and fourth antennal segments.
Fig. 223. *Aphis persicae-niger* Smith, cornicle.
Fig. 224. *Aphis persicae-niger* Smith, third and fourth antennal segments.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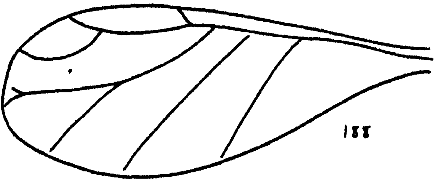
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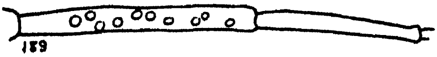
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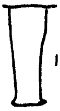
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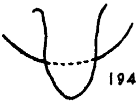
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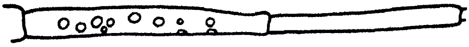
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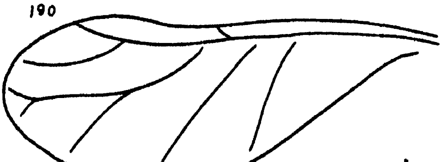
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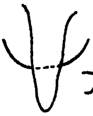
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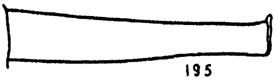
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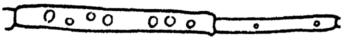
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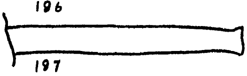
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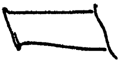
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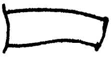
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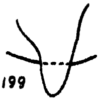
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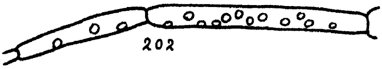
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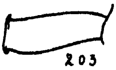
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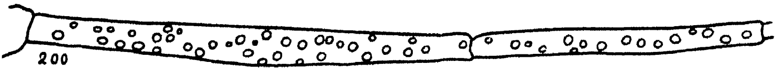
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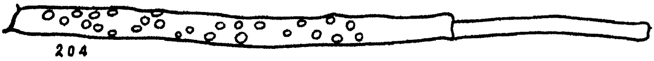
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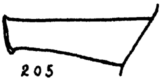
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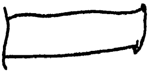
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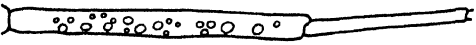
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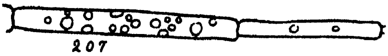
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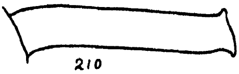
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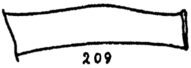
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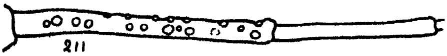
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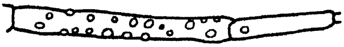
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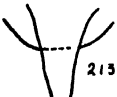
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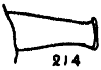
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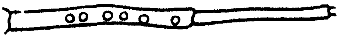
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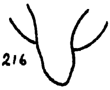
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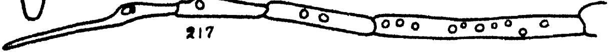
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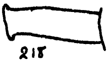
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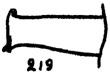
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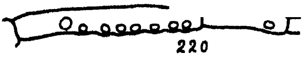
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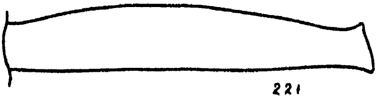
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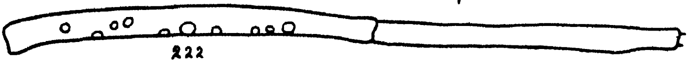
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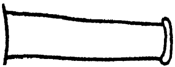
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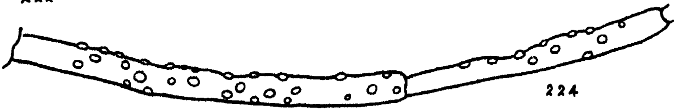
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PLATE 11

Fig. 225. *Aphis pomi* De Geer, cauda.

Fig. 226. *Aphis pomi* De Geer, antennae.

Fig. 227. *Aphis pomi* De Geer, cornicle.

Fig. 228. *Aphis prunorum* Dobr., cauda.

Fig. 229. *Aphis prunorum* Dobr., third and fourth antennal segments.

Fig. 230. *Aphis prunorum* Dobr., cornicle.

Fig. 231. *Aphis pseudobrassicae* Davis, third and fourth antennal segments.

Fig. 232. *Aphis ramona* Swain, antenna.

Fig. 233. *Aphis ramona* Swain, front of head.

Fig. 234. *Aphis ramona* Swain, cauda and anal plate.

Fig. 235. *Aphis ramona* Swain, cornicle.

Fig. 236. *Aphis euonomi* Fabr., cornicle.

Fig. 237. *Aphis euonomi* Fabr., third and fourth antennal segments.

Fig. 238. *Aphis salicicola* Thomas, cornicle.

Fig. 239. *Aphis salicicola* Thomas, third and fourth antennal segments.

Fig. 240. *Aphis sambucifoliae* Fitch, third and fourth antennal segments.

Fig. 241. *Aphis senecio* Swain, cauda.

Fig. 242. *Aphis senecio* Swain, cornicle.

Fig. 243. *Aphis senecio* Swain, front of head.

Fig. 244. *Aphis senecio* Swain, third and fourth antennal segments.

Fig. 245. *Aphis senecio* Swain, fifth, sixth antennal segments, and spur.

Fig. 246. *Aphis setariae* Thomas, cornicle.

Fig. 247. *Aphis setariae* Thomas, third and fourth antennal segments.

Fig. 248. *Aphis malifoliae* Fitch, cornicle.

Fig. 250. *Aphis malifoliae* Fitch, fourth antennal segment.

Fig. 251. *Liosomaphis berberidis* (Kalt.), front of head.

Fig. 252. *Liosomaphis berberidis* (Kalt.), third and fourth antennal segments.

Fig. 253. *Siphocoryne capreae* (Fabr.), third and fourth antennal segments.

Fig. 254. *Siphocoryne capreae* (Fabr.), fifth and sixth antennal segments and spur.

Fig. 255. *Siphocoryne capreae* (Fabr.), cauda and supra-caudal spine of alate females.

Fig. 256. *Siphocoryne capreae* (Fabr.), cauda and supra-caudal spine of apterous females.

Fig. 257. *Siphocoryne pastinacae* (Linn.), third and fourth antennal segments.

Fig. 258. *Siphocoryne pastinacae* (Linn.), fifth and sixth antennal segments and spur.

Fig. 259. *Siphocoryne pastinacae* (Linn.), cauda of apterous female.

Fig. 260. *Siphocoryne pastinacae* (Linn.), cauda of alate female.

Fig. 261. Siphocoryne pastinacae (Linn.), cornicle.

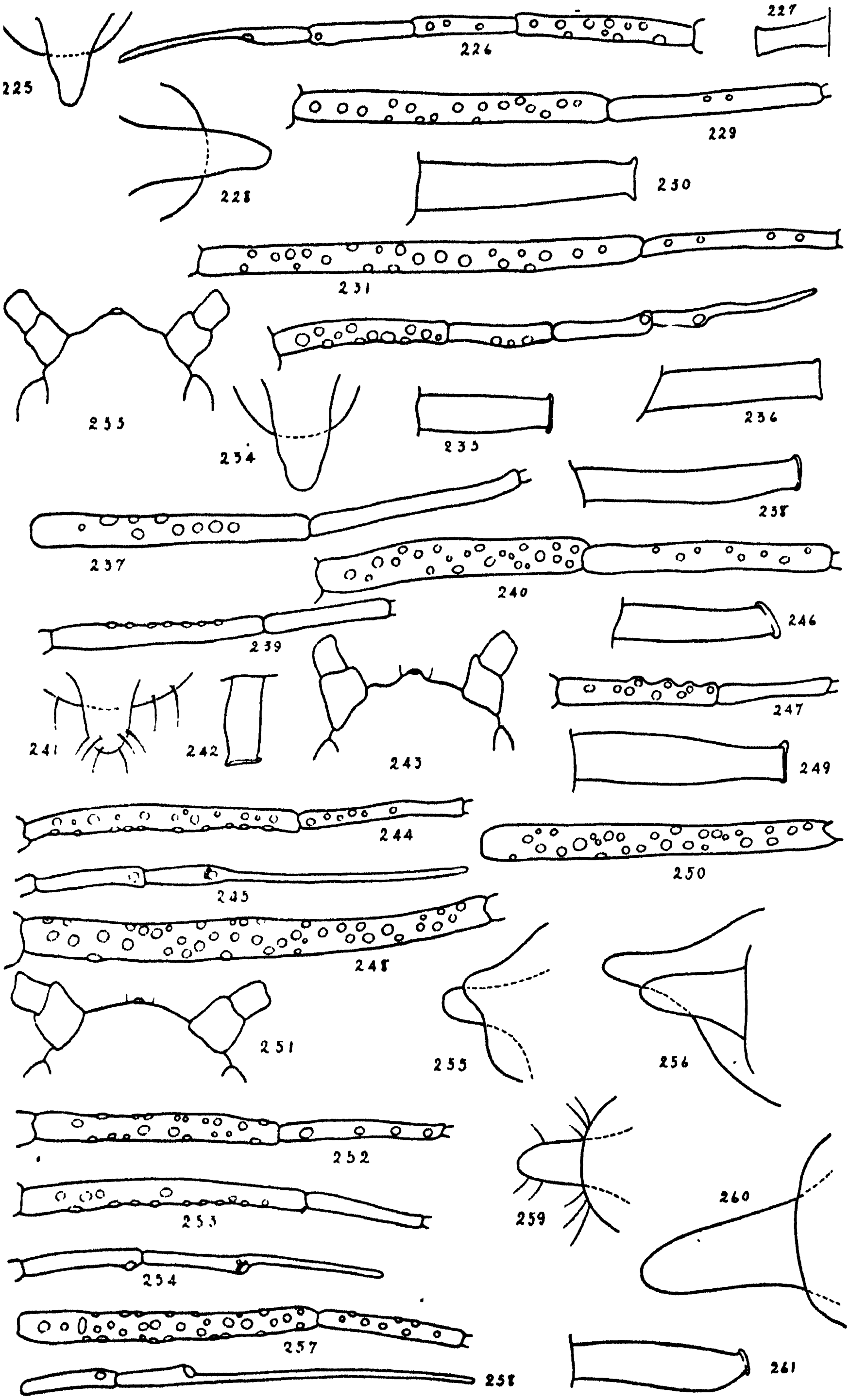
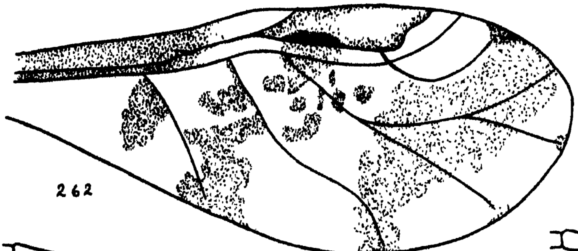


PLATE 12

Fig. 262. *Myzocallis discolor* (Monell), fore wing.
Fig. 263. *Myzocallis discolor* (Monell), third antennal segment.
Fig. 264. *Myzocallis bellus* (Walsh), fore wing.
Fig. 265. *Myzocallis bellus* (Walsh), third antennal segment.
Fig. 266. *Myzocallis californicus Baker* (*maureri* Swain), fore wing.
Fig. 267. *Myzocallis castanicola* Baker (*davidsoni* Swain), fore wing.
Fig. 268. *Myzocallis arundinariae* Essig, third antennal segment.



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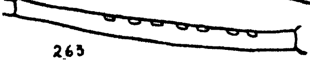

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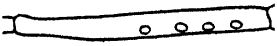

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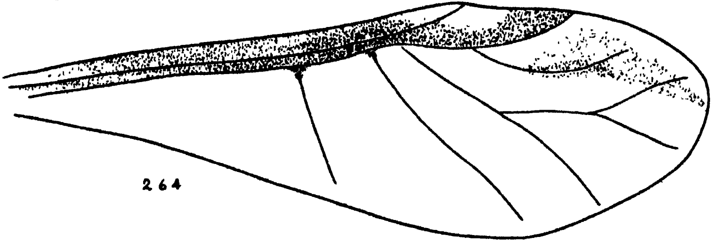

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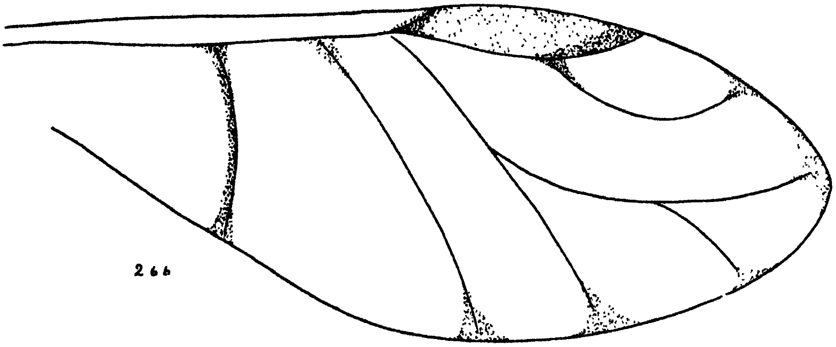

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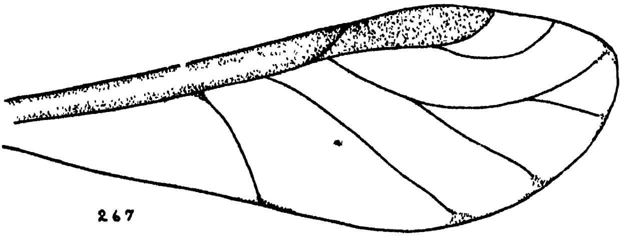

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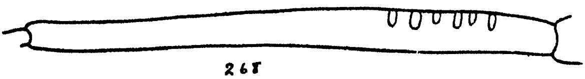

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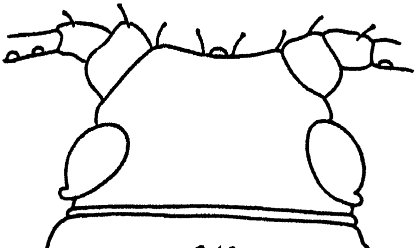
PLATE 13

Fig. 269. *Symydobius chrysolepis* Swain, head.
Fig. 270. *Symydobius chrysolepis* Swain, cornicle.
Fig. 271. *Symydobius chrysolepis* Swain, anal plate.
Fig. 272. *Symydobius chrysolepis* Swain, antenna.
Fig. 273. *Symydobius chrysolepis* Swain, fore wing.
Fig. 274. *Symydobius chrysolepis* Swain, hind wing.
Fig. 275. *Thomasia populicola* (Thomas), fore wing.



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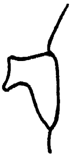

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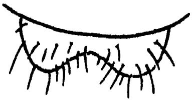

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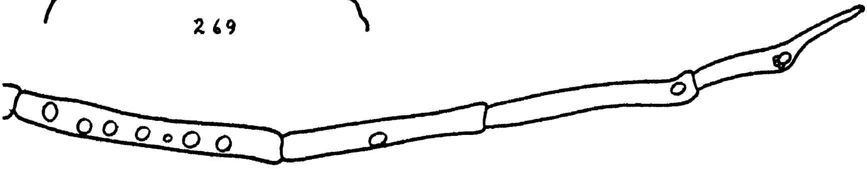

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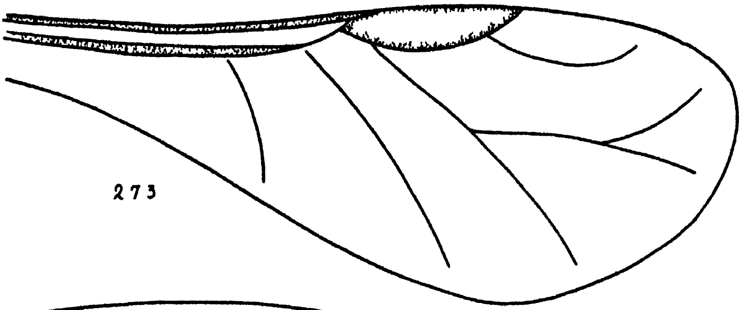

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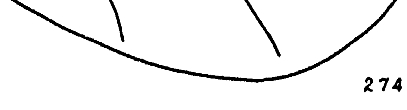

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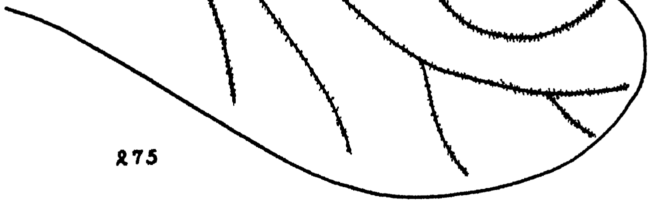

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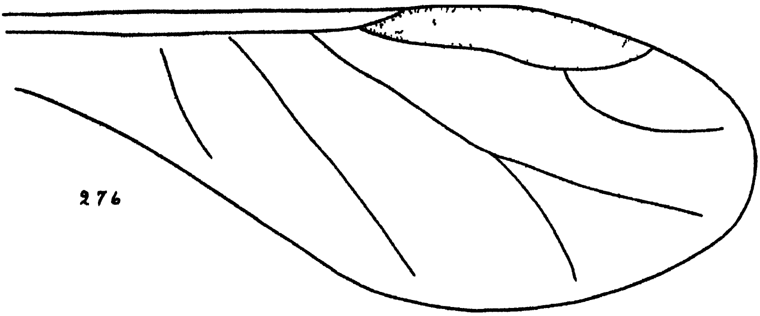
PLATE 14

Fig. 276. *Toxoptera aurantii* (Fonsc.), fore wing.
Fig. 277. *Rhopalosiphum lactucae* (Kalt) head.
Fig. 278. *Rhopalosiphum lactucae* (Kalt.), third antennal segment, aptera.
Fig. 279. *Rhopalosiphum lactucae* (Kalt.), third antennal segment, alate.
Fig. 280. *Rhopalosiphum lactucae* (Kalt.), fourth and fifth antennal segments, alate.
Fig. 281. *Rhopalosiphum lactucae* (Kalt.), sixth antennal segment, alate.
Fig. 282. *Rhopalosiphum lactucae* (Kalt.), cornicle, alate.
Fig. 283. *Rhopalosiphum lactucae* (Kalt.), cauda, alate.
Fig. 284. *Rhopalosiphum lactucae* (Kalt.), cornicle, aptera.
Fig. 284*a*. *Rhopalosiphum lactucae* (Kalt.), cauda, aptera.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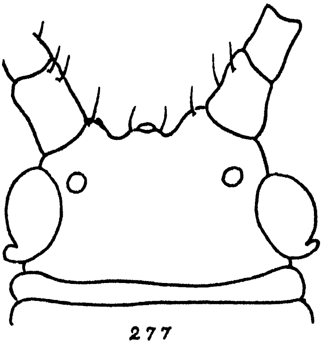
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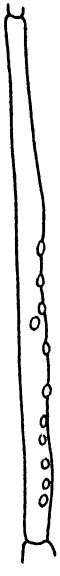
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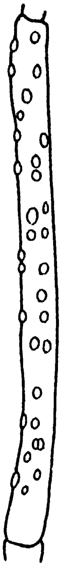
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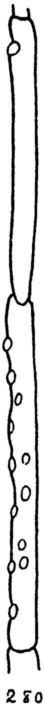
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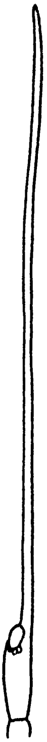
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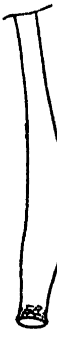
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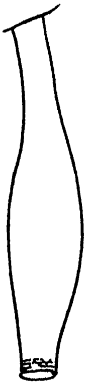
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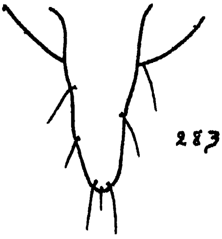
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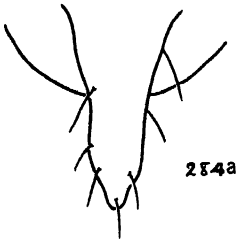
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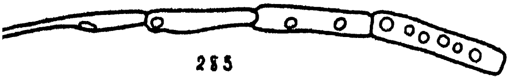
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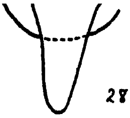
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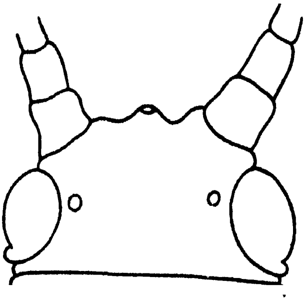
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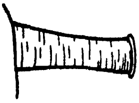
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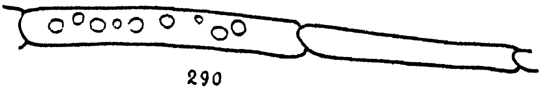
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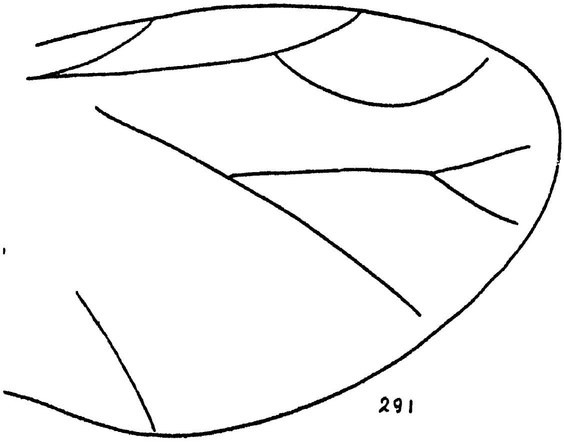
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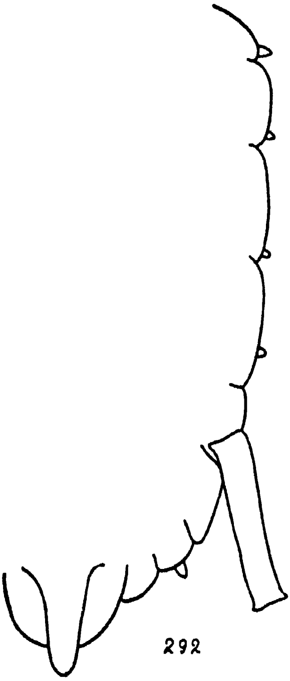
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Fig. 293. *Aphis marutae* Oest., head.

Fig. 294. *Aphis marutae* Oest., third and fourth antennal segments.

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Fig. 296. *Aphis marutae* Oest., antenna, aptera.

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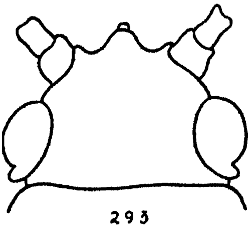

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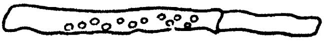

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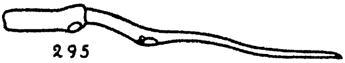

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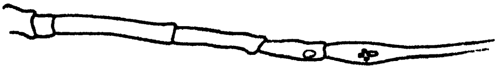

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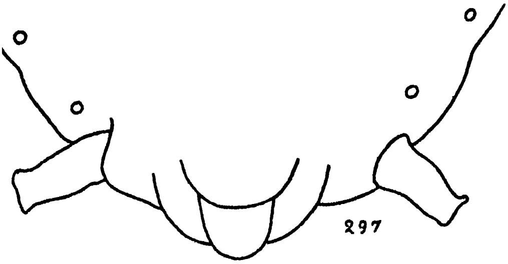

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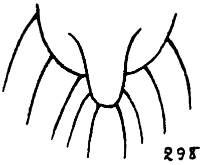

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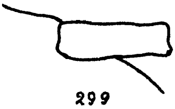

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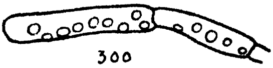

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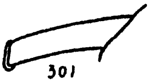

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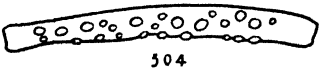

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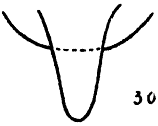

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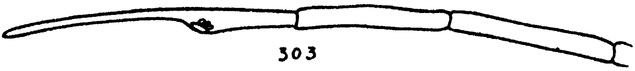

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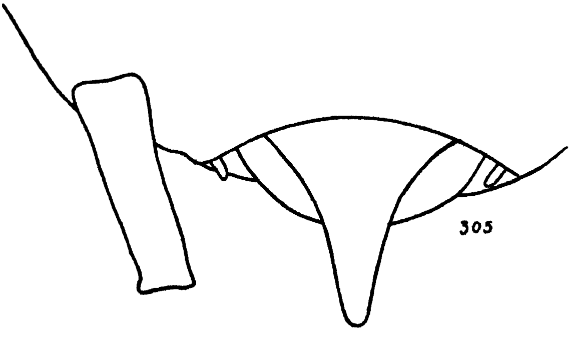

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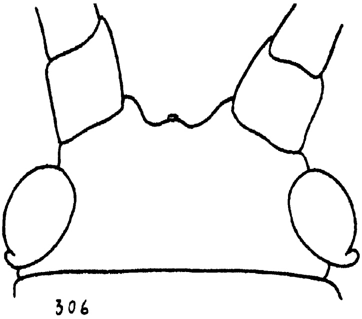

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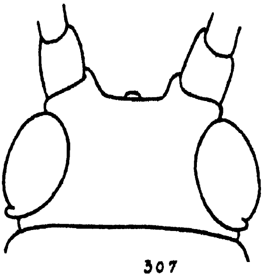

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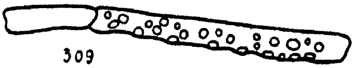

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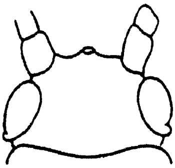

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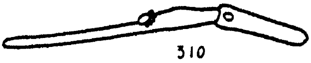

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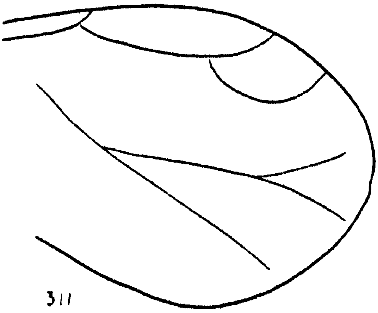

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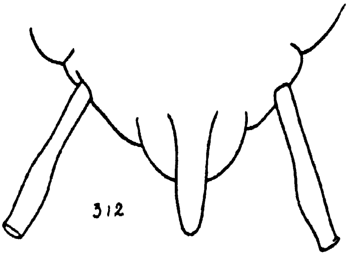

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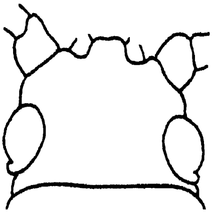

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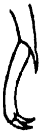

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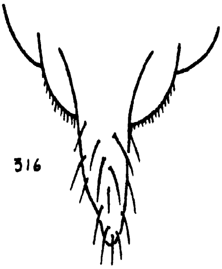

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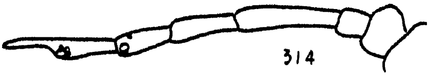

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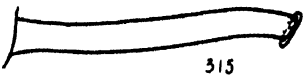

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PART I

TAXONOMIC STUDIES

BY

P. H. TIMBERLAKE

In the fall of 1919 Mr. C. P. Clausen made extensive collections of the grape mealybug, *Pseudococcus maritimus* (Ehrhorn), at Fresno, California, for the purpose of studying its parasites, and at that time discovered nine species of chalcid-flies, besides three more which he had previously reared from the same host in Southern California. These three latter species, *Chrysoplatycerus splendens* (Howard), *Zarhopalus sheldoni* Ashmead, and *Pseudaphycus angelicus* (Howard), being comparatively well known, will not be considered here; but of the species from Fresno Mr. Clausen has requested me to give a systematic review as a preliminary to his own account of their biology and habits. According to Clausen's observations five of these parasites are primary and four secondary in habits. Of the primary parasites, four of the species have been described by A. A. Girault from material collected at Fresno by Harry S. Smith and R. L. Nougaret. With the exception of *Acerophagus notativentris* (Girault) these species require further consideration on account either of incorrect generic allocation or because the male sex has not been previously known. Accordingly, each parasite is listed below with such descriptive notes and remarks as were deemed necessary to clear up points of obscurity. The types of the new species will be deposited in the United States National Museum.

For aid in determination of two of the secondary parasites, I am indebted to Mr. A. B. Gahan, who has compared material with types in the National Museum.

Family **Encyrtidae**

Tribe **Ectromatini**

Anagyrus Howard

This genus has been much misunderstood as many of its species have been described under other genera. Not a few placed here by Girault belong to *Anagyropsis* and elsewhere. The European species were included by Mayr in *Blastothrix;* and a few others have been described since in this genus, but they differ greatly from the genotype, *Blastothrix sericea* (Dalman). These species include *bohemani* (Westwood), *shönherri* (Westwood), *yuccae* (Coquillett), *insolitus* (Howard), and *subproximus* (Silvestri). Masi has also described and figured under *Blastothrix* an unnamed species from the Seychelles Islands.

Anagyrus has been confused also with *Dinocarsis* Förster to which it is really closely related. *Dinocarsis* differs principally in being more robust, with the mesoscutum shorter than the scutellum and with the axillae more or less widely separated, whereas *Anagyrus* is slenderer, with the mesoscutum as long or usually longer than the scutellum and with the axillae contiguous or almost meeting medially. Species of *Anagyrus* that were described under *Dinocarsis* include *thyridopterygis* (Ashmead), *pulcher* (Ashmead), *abnormis* (Girault), and *flavimesopleurum* (Girault).

A few species have been described under *Aphycus* Mayr, a genus which they superficially resemble in type of sculpture, coloration, expanded scape, and venation. These include *dactylopii* (Howard), *nigritus* (Howard), and *townsendi* (Howard).

The genus *Epidinocarsis* Girault was erected for certain Australian species which differ from typical *Anagyrus* in some minor points, but probably it will not be practicable to recognize them as forming more than a subgenus of *Anagyrus;* Girault, himself, has fully synonymized his genus. Besides the Australian species described under *Epidinocarsis*, there are two others, *pseudococci* (Girault) and *subalbicornis* (Girault), which belong to *Anagyrus* in the strictest sense.

Ashmead also referred two species of *Cerchysius* described by Howard to *Anagyrus*, but just how correctly I am unable to determine as the types have not been accessible. It is apparent from the descriptions that these two species are certainly not *Cerchysius*, nor on the other hand are they quite typical of *Anagyrus*, although they seem to be closely allied thereto.

In 1913 Brèthes erected the genus *Paranusia* for a South American species, which is at least closely allied to *Anagyrus*, and possibly not different enough to be regarded as the type of a distinct genus. I regard his genus *Philoponectroma* as the presumptive male of *Paranusia*. This presumption would become nearly a certainty if we knew that the types were reared from the same host, which appears to be the actual case from the data given by Brèthes.

Anagyrus as it is now recognized was accurately placed by Ashmead in his generic tables, and it has recently been correctly used by Mercet in his monograph of the Encyrtidae of Spain, except in regard to the male sex, which is placed by him under *Philoponectroma*, whereas the males described under *Anagyrus* differ in several important characters from the true male of *Anagyrus*.

Besides the Australian species described by Girault under *Anagyrus*, but later distributed to other genera, there are two North American species which I believe should be removed. *Anagyrus pallidipes* Ashmead, I think, should be removed to a new genus, and *Anagyrus nubilipennis* Girault evidently belongs to *Coccidoxenus*, and may be cited as *C. nubilipennis* (Girault).

The species of *Anagyrus* appear to be numerous. It would not be surprising if hundreds of species are finally discovered and described, especially from the tropics. Most of these species are parasitic in mealybugs of the genus *Pseudococcus* and allied genera of the Dactylopiinae. The numerous species which I have seen show great plasticity in structure, especially in sculpture, pilosity, shape of the head, position of antennae, venation, etc., so that the genus might be considerably subdivided into more or less natural sections or subgenera. Just how far these groups actually intergrade with one another can be determined only by the accumulation of much more material than is available at present.

The North American species remaining in *Anagyrus* may be separated as follows:

FEMALES

1. Frontovertex in dorsal view of head distinctly longer than wide. 3
   Frontovertex about as wide as long.. 2

2. Scape very wide or about one-half as wide as long; wings of normal shape; general coloration orange-yellow, pedicel and club black, funicle entirely white .... **townsendi** (Howard)
   Scape about one-third as wide as long; wings narrow, their greatest width not over one-third of their length; general coloration blackish, the funicle and club entirely black .... **nigritus** (Howard)

3. Ocellar triangle more nearly rectangular, the frontovertex about one-fourth longer than wide 4
Ocellar triangle more or less acute; frontovertex one-half or more longer than wide 6

4. Most of scape except base and apex, pedicel except extreme apex, and first funicle joint black, rest of antennae yellowish white 5
Antennae with first two funicle joints black, otherwise the same; general color of head and thorax orange-yellow, with cheeks, lower part of face, occiput, collar of pronotum, axillae, and scutellum partly blackish, propodeum and abdomen black, legs pale dusky yellowish, the hind femora brown along inner dorsal margin, and hind tibiae blackish except towards apex .... **clauseni** n. sp.

5. General coloration black, the frontovertex and dorsum of thorax brown, the pleura yellowish; legs pale yellowish with the hind femora and base of hind tibiae brown .... **yuccae** (Coquillett)
Like *yuccae* except the thorax above is black with a trace of brownish on the sides of mesoscutum and on the axillae in some specimens, the frontovertex with brown or mostly black; legs without brown on the hind femora and tibiae .... **subalbicornis** (Girault)

6. Frontovertex with small, scattered pin-punctures; head and mesoscutum black, the scutellum orange-yellow; pedicel and first five funicle joints black, last funicle joint and club white .... **thyridopterygis** (Ashmead)
Frontovertex without pin-punctures; head and thorax bright orange-yellow; pedicel and first three funicle joints black, last three funicle joints and club white .... **pulcher** (Ashmead)

Anagyrus clauseni n. sp.

Figure 1

Female.—General shape of head nearly as in *A. pseudococci* (Girault), being submenisciform and moderately thin fronto-occipitally; as seen from the side, anterior outline is nearly uniformly rounded; as seen from in front, it is slightly wider than long, the eyes protuberant below, the cheeks converging toward the mouth; as seen from above, anterior outline is well rounded, occipital margin concave; frontovertex continuous with the face and moderately widening anteriorly, the portion seen in dorsal view about a fourth longer than wide; ocellar triangle nearly equilateral, the posterior ocelli about their own diameter from the eye margin and somewhat more distant from the occipital margin; eyes large, broadly oval, a little diverging below; cheeks somewhat shorter than the width of the eyes; antennal scrobes in the form of rather shallow groves, slightly converging above and reaching well upward between the eyes.

Antennae (fig. 1) inserted moderately close to the oral margin, the sockets narrowly oval, subparallel and placed hardly more than their own length apart; scape broadly expanded or nearly one-half as wide as long, the ventral margin uniformly rounded; pedicel elongate, slightly longer than the second funicle joint but shorter than the first; flagellum cylindrical, increasing slightly in width distad, the funicle joints becoming successively shorter although the second and third joints are about equal; first funicle joint about a half longer than the sixth, the latter nearly a half longer than wide; club oval, equal in length to the last two funicle joints and one-half of the fourth joint combined, and somewhat wider.

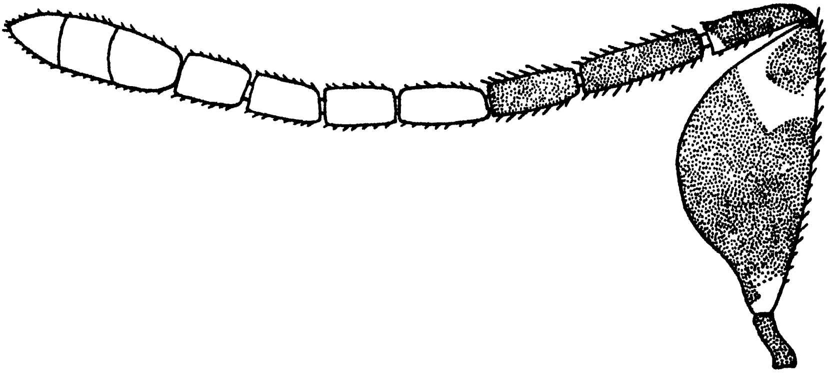

Fig. 1. *Anagyrus clauseni* n. sp.: antenna of female.

Thorax of normal structure, or practically as in *pseudococci*, *dactylopii*, and allied species, the posterior margin of the mesoscutum very obtusely angulate medially, and not sinuate on either side of the middle; abdomen as long as the thorax, of normal structure, the ovipositor not protruded.

Wings broad and reaching far beyond apex of abdomen; marginal vein about three times as long as thick and a little shorter than the slender stigmal vein, postmarginal spur-like and not over one-half as long as the marginal; speculum broad, not quite reaching to the stigmal vein and widely separated from the posterior margin of the wing, but with a small cut-off portion close to the posterior margin; disk of wing before the speculum uniformly ciliated, the setae next to the speculum not greatly coarser than those beyond.

Head and body mostly opaque, with extremely fine or microscopic reticulate thimble-like punctures, under low magnification appearing alutaceous; the tergum of abdomen with considerably coarser but otherwise similar sculpture; propodeum, except toward the sides and the sides of the venter, much smoother and somewhat shining. Eyes covered with short, erect, and rather numerous setae; face, cheeks, posterior orbital region of head, pronotum and mesonotum covered with abundant whitish appressed and somewhat scale-like hairs, those on the thorax seriately arranged; scutellum also with three pairs of short blackish bristles on each side near the apex, decreasing successively in size anteriorly; metapleura rather thickly clothed with whitish hairs not concealing the surface, most of which are less scale-like and more erect than those of the mesonotum; abdomen above with similar but much sparser hair, very short and fine at the base, and becoming much longer toward the apex.

Frontovertex and face orange (Ridgway), the thorax above about Mars yellow, the propleura and mesopleura yellow ocher (Ridgway) with the sutures narrowly fuscous and the prepectal plates slightly paler ochreous; tegulae creamy white with a triangular pale fuscous spot in the middle of apical margin; facial prominence between antennae, a spot on either side of face just outside of the antennal sockets, the occipital margin of cheeks, most of occiput except the dorsal margin, and collar of pronotum, fuscous; axillae except apical and lateral margins, entire margin of scutellum, and a medium longitudinal band from its base somewhat more than halfway to apex, brown to fuscous; metanotum, propodeum, metapleura, and abdomen, fuscous. Scape, pedicel, and first two funicle joints, fuscous; base and subapical cross-band of scape, extreme apex of pedicel and rest of flagellum, yellowish white. Legs cream color (Ridgway), the middle and most of hind coxae fuscous; dorsal margin of front legs from base of coxae to apex of tibiae pale brownish; a spot at apex of middle femora above, and dorsal margin of middle tibiae except at apex, dilute fuscous; inner surface of hind femora next to the dorsal margin, the hind tibiae except toward apex and especially on the lower side, and hind tarsi, fuscous; front tarsi and the four apical joints of middle tarsi brown. Wings hyaline, the veins dilute fuscous.

Length of body: 1.73; length of head: 0.580; width of head: 0.622; width of vertex: 0.221; width of mesoscutum: 0.662; length of forewing: 1.71; width of forewing: 0.754 mm.

Male.—Unknown.

Described from one female (type) reared October 15, 1919, from *Pseudococcus maritimus* (Ehrhorn) on grape, Fresno, California (C. P. Clausen), Clausen's no. 907. The type is in good condition except that the flagellum of one antenna is missing.

Anagyrus subalbicornis (Girault)

Plate 19, figure 3

Epidinocarsis subalbicornis Girault, Psyche, vol. 23, p. 44, 1916, ♀.

The female of this species is nearly identical in structure with *clauseni* and except for coloration I am able to point out only minute and illusive differences. The marginal vein is slightly thicker in *subalbicornis*, distinctly more widened at the juncture with the stigmal, and the latter is somewhat thicker and not narrowed toward the base as in *clauseni*. The ocellar triangle is slightly more rectangular with the posterior ocelli a trifle farther apart, each one being about equidistant from the eye and occipital margins. The funicle of the antenna (fig. 2*a*) is also slightly slenderer than in *clauseni*. In June, 1917, I compared *subalbicornis* with the type of *yuccae* but noted no structural differences. The main differences in color between the three species are brought out in the table of species. Measurements of the female follow for comparison with the male, and with the female of *clauseni*.

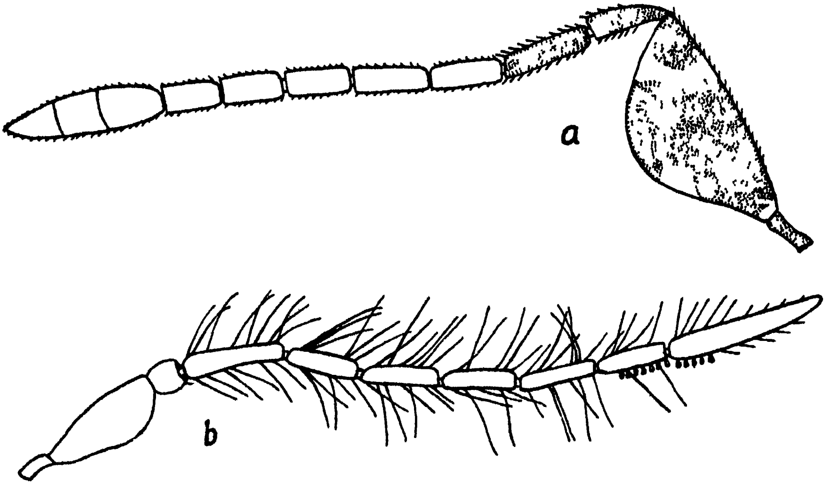

Fig. 2. *Anagyrus subalbicornis* (Girault): *a*, antenna of female; *b*, antenna of male.

Length of body: (1.49 to 2.17) 1.72; length of head: 0.549; width of head: 0.608; width of vertex: 0.226; width of mesoscutum: 0.613; length of forewing: 1.60; width of forewing: 0.697 mm.

Male.—Head rather thinner fronto-occipitally than in the female but much less menisciform, as the face and frons are separated by a distinct angle; as seen from the side, the dorsal surface is well rounded to a little below the middle of the eyes and from that point to the oral margin the outline is nearly straight; as seen from in front, the head is about as wide as long, uniformly rounded in outline above, but strongly convergent from the eyes to the narrow mouth; eyes much smaller, more rounded, and about a third longer than wide; frontovertex fully a third wider than long and somewhat wider anteriorly; ocelli larger, in a right-angled triangle, the posterior pair almost touching the occipital margin and about one and a half times their own diameter from the eye margins; cheeks almost as long as the eyes; face longer than wide; nearly plane or very slightly convex below, greatly concave above between the eyes, the antennal scrobes in the form of short, parallel, very shallow grooves near the middle of the concavity, the usual facial prominence between the antennae very weak.

Antennae (fig. 2*b*) inserted high up on the face on a level with the lower corners of the eyes, the sockets broadly oval, slightly converging above and about their own length apart. Scape rather short, somewhat expanded beneath, appearing narrowly oval in lateral view, a little over one-third as wide as long excluding the radicle; pedicel no longer than thick and distinctly thicker than the flagellum; funicle joints elongate, cylindrical, notched above at the articulations, the last five joints subequal, each about a fourth shorter than the first joint; club solid, elongate cylindrical, and tapering to an acute apex, in length distinctly greater than the two preceding joints combined. Flagellum clothed with long erect hairs, gradually shortening toward the apex beginning with the last funicle joint, and arranged in indistinct whirls except on the club, where they are scattered and more numerous as well as shorter; first funicle joint with about five whirls, the following joints each with two whirls or one close to either end and with several additional hairs near the middle of each; in addition the hairs on the lower side of the joints are shorter and decumbent; ventral margin of the last funicle joint and base of club ornamented with a continuous row of small erect elongate oval whitish scales, arranged respectively seven and five on each.

Thorax as in the female; abdomen somewhat shorter than the thorax and shaped nearly as in the female except that the apex is more rounded and the tergum is not sunken in after death.

Forewings proportionately wider than in the female; marginal vein shorter, about twice as long as thick and not enlarged distad as in the female, the postmarginal vein much slenderer at base but the stigmal vein about the same; speculum wide, separated from the stigmal vein by only two or three fine setae and rather narrowly separated from a cut-off portion next to the posterior margin; lying just before and parallel with the speculum and separated therefrom by a double row of coarser setae is a second hairless band somewhat narrower and shorter than the other; the basal part of the wing otherwise well covered with setae.

Sculpture and vestiture nearly as in the female, but the hair on the thorax not so conspicuously white; the face, however, more thickly and conspicuously white-haired.

Head and body opaque black, the mesopleura yellow ocher (Ridgway), propleura slightly paler ochreous, the prepectal plates and tegulae creamy white, the latter with a large quadrate fuscous spot at outer apical corner. Antennae black, the flagellum becoming dilutely fuscous toward the apex; the basal third of the scape (excluding radicle) white and the ventral margin on apical half transparent white. Legs creamy white, the hind femora slightly dusky, hind tibiae except toward apex on the lower side, hind and front tarsi and most of middle and hind coxae fuscous, the last four joints of middle tarsi nearly black. Wings hyaline, the veins fuscous.

Length of body: (1.18 to 1.32) 1.23; length of head: 0.466; width of head: 0.504; width of vertex: 0.275; width of mesoscutum: 0.518; length of forewing: 1.37; width of forewing: 0.645 mm.

The material of *subalbicornis* studied includes 4 females reared in October, 1914, by H. S. Smith, California State Insectary No. 675; and 27 females, 3 males reared in October and November, 1919, by C. P. Clausen, all from the grape mealybug, *Pseudococcus maritimus* (Ehrhorn), at Fresno, California.

Pseudleptomastix Girault

This genus is similar to *Leptomastix* Mayr and *Leptomastidea* Mercet, but differs in the reticulate sculpture, the black coloration with a distinct metallic luster on certain portions of the body, and the white tegulae, and prepectal plates.

Pseudleptomastix squammulata Girault

Pseudleptomastix squammulatus Girault, Ann. Entom. Soc. Am., vol. 8, p. 272, 1915, ♀.

Paraleptomastix notatus Girault, Entomologist, vol. 50, p. 38, 1917, ♀.

The female has been described twice by Girault. The synonymy cited above is based on examinations of the types in the United States National Museum. The general color of the female is much less greenish than might be gathered from Girault's first description, as the rather slight greenish luster of the vertex and mesoscutum is not at all apparent in certain aspects. The scutellum is opaque black, the face, cheeks, and mesopleura are dark blue or purplish, and the abdomen is not black but as compared with the mesopleura rather brilliant metallic blue and purple, and practically bare.

Moreover, I would call the head rather distinctly denisciform as it forms nearly a hemisphere in outline in side view, but with the curvature slightly oblated below. In frontal view the head is almost circular with the oral margin distinctly projecting beyond the outline of the circle. The eyes are large, rather broadly oval, and broadly continuous above with the occipital margin; the cheeks are moderately long or about equal to two-thirds of the width of the eyes.

As compared with several undescribed species in my collection the following appear to be the most important specific characters: the slight duskiness of the wings; the frontovertex nearly twice as long as the posterior width when measured from the occipital margin to the apex of the scrobes; the very gradual and comparatively slight increase in width of the frontovertex anteriorly; the pubescence of mesoscutum entirely whitish, and the comparative shallowness of the facial impression and scrobes.

The measurements of a female of maximum size are as follows: length of body: 1.296; length of head: 0.447; width of head, 0.454; width of vertex: 0.188; length of antennae, 1.089; width of mesoscutum: 0.440; length of forewing: 1.202; width of forewing: 0.450 mm.

Male.—Head considerably thinner fronto-occipitally and much less denisciform than in the female and with a distinct obtuse angulation between the planes of the face and frontovertex; as seen from above the anterior outline is well rounded, the occipital outline slightly concave; as seen from in front the outline above is circular, but the rather long cheeks below converge sharply toward the narrow mouth;

as seen from the side the dorsal outline is only slightly convex and about a third shorter than the straighter facial outline. Eyes much smaller or hardly longer than wide, narrower above toward the occipital margin, their general shape that of an isosceles spherical triangle; frontovertex about a half wider than long; the large ocelli in an obtuse-angled triangle, the posterior pair almost touching the occipital margin and distinctly more than their own diameter from the eye margin; cheeks about as long as the greatest width of the eyes; face slightly longer than wide, the prominence between the antennae in the form of a narrow longitudinal ridge reaching from the oral margin to just above the antennal sockets; scrobal impression subcircular but divided in its lower half by the facial ridge, and in the upper part two slightly deeper and smoother grooves originating at the antennal sockets, which converge sharply in the first half of their length and then abruptly ascend almost parallel.

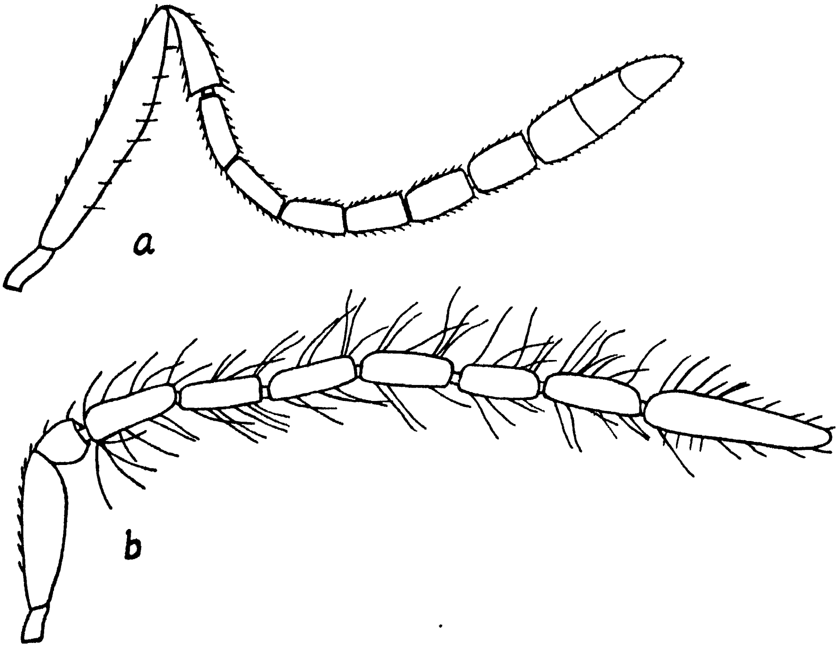

Fig. 3. *Pseudleptomastix squammulata* Girault: a, antenna of female; *b*, antenna of male.

Antennae (fig. 3*b*) inserted high up on the face with the sockets situated on the ocular line; scape of moderate length or somewhat shorter than the pedicel and first two funicle joints combined, compressed, and subfusiform as seen from the side; pedicel about as long as thick and about one-third as long as the first funicle joint; flagellum elongate, cylindrical, with long, more or less verticillate hairs which decrease in length toward the apex of the club, the first and sixth funicle joints with three whirls, each of the remaining funicle joints with two whirls, the hairs on the club more evenly distributed; funicle joints all about three times as long as thick and moderately excised at the articulations; club entire, about as long as the last two funicle joints combined and tapering to the acute apex.

Thorax and abdomen nearly as in the female. Wings considerably shorter and proportionately wider, the fringe of the posterior margin slightly longer; marginal vein shorter than in the female and somewhat shorter than the stigmal, the latter forming an angle of about 65 degrees with the postmarginal vein, moderately long and triangularly enlarged toward the apex, the postmarginal somewhat longer than the stigmal and fully twice as long as the marginal vein.

Head more rugosely reticulate than in the female, with the reticulations becoming nearly effaced on the cheeks and lower part of the face; sculpture of the thorax nearly as in the female except on the scutellum which is very finely reticulate and slightly shiny, whereas in the female there is a very dense, fine, thimble-like puncturation producing an opaque effect. Pubescence much as in the female, except that the fine, white, appressed hairs of the mesoscutum are confined to the basal half.

Head shining black and with a very slight dark greenish luster; mesoscutum and axillae nearly like the head, the scutellum somewhat shiny black and not at all metallic; prothorax, propodeum, and mesopleura shiny blackish or fuscous; the prepectal plates and tegulae pale yellowish white, the latter dilutely fuscous on the apical margin; abdomen shining black, the basal tergite and underparts with a rather weak bluish luster. Antennae fuscous, but paler or slightly yellowish toward the base of the scape, the legs yellowish including the front and middle coxae, but the hind coxae and femora fuscous or blackish, the dorsal side of the apical joints of the front and middle tarsi, the dorsal side of the hind tarsi almost entirely, and that of the hind tibiae, fuscous or brownish. Wings very faintly smoky, somewhat clearer than in the female, or almost hyaline; the veins pale brownish.

Length of body: 0.926; length of head: 0.292; width of head: 0.327; width of vertex: 0.186; length of antenna: 1.077; width of mesoscutum: 0.315; length of forewing: 0.855; width of forewing: 0.388 mm.

Redescribed from two females reared in October, 1914 (H. S. Smith), California State Insectary No. 675; and four females, one male reared in November, 1919 (C. P. Clausen), all from *Pseudococcus maritimus* (Ehrhorn) collected at Fresno, California.

Zarhopalus Ashmead

Zarhopalus Ashmead, Proc. U. S. Nat. Mus., vol. 22, p. 342, 406, 1900.
Anagyrella Girault, Jour. New York Entom. Soc., vol. 23, p. 168, 1915.

Three species of this genus have been found in the United States, the first one of which was described by Howard in 1881 as *Encyrtus inquisitor.* Recent references to *Aphidencyrtus inquisitor* based on the supposed type of Howard's species do not relate to this species, which by the original description and figure clearly belongs to *Zarhopalus.* The real type of *inquisitor* may be lost as I have not been able to find it at the National Museum. The species was based on a single female specimen reared from *Pseudococcus citri* (Risso) on orange at Jacksonville, Florida. The two species from St. Vincent, *Encyrtus crassus* and *E. quadricolor* both of Howard, included by Ashmead, apparently do not belong to *Zarhopalus.*

The male of *Zarhopalus* has not been described, for although Ashmead included the genus in his tables for the male sex, it was placed altogether on supposition and mostly incorrectly. The principal generic characters of the male are as follows:

Male.—Head rather thin fronto-occipitally, the frontovertex about as wide as long, the face strongly inflexed and with a large, deep, subcircular scrobal impression. Antennae inserted about halfway between the ocular line and the oral margin; the scape short and fusiform, reaching slightly beyond the scrobal impression; pedicel short but a little longer than thick and slenderer than the following joints; flagellum thick and cylindrical, the funicle joints much shorter than wide and subequal in length; club entire and about as long as the three preceding joints combined. Mandibles narrow at apex, indistinctly tridentate, with a median acute tooth, and a much shorter and rather indistinct tooth on each side.

Thorax strongly convex above, the pronotum very short and strongly arcuate; mesoscutum large, about twice as wide as the median length; axillae slightly separated medially; scutellum convex, rounded at apex, a little shorter than the mesoscutum, the sides well elevated and roundingly declivous. Abdomen considerably shorter than the thorax, strongly depressed, the basal corners and apex well rounded. Wings rather short and broad, the costal cell wide; the submarginal vein slender throughout and reaching to the middle of the disk; marginal vein slightly longer than thick or nearly punctiform; stigmal vein of moderate length and at an angle of about 45 degrees with the margin; postmarginal vein about a half longer again than the stigmal; disk of wing including basal area moderately thickly pubescent with very short setae, the speculum distinct, marginal cilia very short. Legs of normal length; the middle tarsi not thickened toward the base, the tibial spur short; hind tarsi long and slender and distinctly longer than the middle pair.

Head and body finely shagreened, the face, apex, and sides of scutellum, and apical half of the abdomen smoother, the frontovertex with numerous fine pin-punctures. Pubescence very fine and inconspicuous but rather abundant on the mesoscutum; the scutellum medially with several lines of fine hairs, the eyes with fine, short pubescence. Coloration metallic, but rather dull.

The three species found in the United States may be separated as follows:

FEMALES

1. Frontovertex hardly more than a half longer again than wide and with sparse fine punctures; ocelli in an obtuse-angled triangle 2
   Frontovertex about twice as long as wide, much more distinctly and closely punctured, ocelli in a right-angled triangle; scape comparatively broad; coloration bluish black with a slight greenish luster on the frontovertex and notum in certain aspects; wings comparatively deeply stained but becoming somewhat clearer at the base .... **corvinus** (Girault)

2. Scape compressed and moderately expanded beneath on the inner side; face smooth, the mesoscutum less distinctly punctured than the frontovertex; coloration bluish or greenish black, generally with a strong greenish luster on the frontovertex and notum; wings clear at the base and more or less deeply stained on the remaining part .... **sheldoni** Ashmead
   Scape subcylindrical and slightly widened toward the apex, frontovertex and face delicately punctured, the mesoscutum with coarser punctures; coloration black with a bluish luster on the head, coppery reflections on the mesoscutum, and purplish on the scutellum and abdomen; wings clear on the basal third, the remaining part clouded .... **inquisitor** (Howard)

Zarhopalus corvinus (Girault)

Plate 18, figure 1

Anagyrella corvina Girault, Jour. New York Entom. Soc., vol. 23, p. 169, 1915, ♀.

Female.—Length of body: (0.947 to) 1.713; length of head: 0.553; width of head: 0.662; width of vertex: 0.221; length of antenna: 0.867; width of mesoscutum: 0.645; length of forewing: 1.369; width of forewing: 0.575 mm.

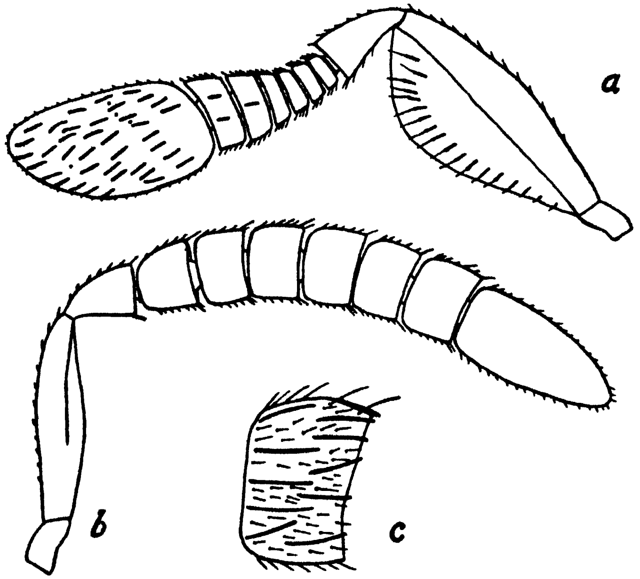

Fig. 4. *Zarhopalus corvinus* (Girault): *a*, antenna of female; *b*, antenna of male; *c*, sixth funicle joint of male antenna more enlarged.

Male.—Head somewhat thinner fronto-occipitally than in the female, thickest considerably above the middle (in female thickest at the middle), the dorsal surface much more rounded from side to side, in lateral view the facial outline is considerably longer than the dorsal (about equal in the female) and the angle formed is slightly more than 90 degrees; as seen from in front it appears much less broad compared with the length, and is well rounded above but the cheeks converge sharply toward the mouth; eyes much smaller, nearly circular in outline (in female about a half longer again than wide) but rather prominent in frontal view of head; frontovertex quadrate or as wide as long, not distinctly foveate in the outer posterior corners behind the lateral ocelli, as in the female; ocelli large, in an obtuse-angled triangle, the posterior pair close to the occipital margin and somewhat more distant from the margin of the eyes; face and cheeks considerably longer than in the female, the latter with a faint genal suture; facial impression fully as deep as in the female but the prominence between the antennae is about twice as long as wide and not broadened toward the mouth (in the female it is almost as wide as long, very broad at the oral margin and narrowed above).

Antennae (fig 4 *b* and *c*) inserted higher up on the face and closer together than in the female, the sockets being somewhat more than their own length from the oral margin and about twice their length apart; scape only slightly expanded or fusiform in shape, including the radicle joint about as long as the pedicel and first three funicle joints combined; pedicel short and thick, about a half longer than wide and a little longer than the first funicle joint; flagellum stout, cylindrical, slightly thicker at the middle, and clothed with extremely short, fine hairs as seen under high magnification; funicle thicker than the pedicel, six-jointed, each joint distinctly wider than long, about equal in length, and circular in cross-section; club entire, tapering to the rounded apex, and about equal to the last three funicle joints combined.

Thorax less robust than in the female, the mesoscutum about twice as wide as the median length (nearly thrice as wide in female); axillae slightly separated at tips; scutellum large, rounded at apex, and slightly shorter than the mesoscutum. Abdomen small, depressed, somewhat wider than long, and broadly rounded at apex; the vibrissal or cercal plates situated on the lateral margin just in front of the middle, the vibrissae rather short and inconspicuous. Wings considerably broader than in the female; marginal vein longer, being a little longer than thick; postmarginal vein as long as in the female but the stigmal much shorter, straight, slightly enlarged at apex and forming an acute angle with the postmarginal vein. Legs about as in the female, the middle tarsi not tapering toward the apex, the tibial spur about two-thirds as long as the first tarsal joint, which is equal to the next three joints combined, hind tarsi unusually long as in the female, or nearly as long as the hind tibiae and distinctly longer than the middle tarsi.

Frontovertex with close, shallow pin-punctures, producing a finely rugose effect, the area between the ocelli transversely shagreened; face and cheeks very delicately and microscopically shagreened but appearing smooth and shining; mesoscutum and axillae very finely reticulate and with numerous minute setiferous punctures; scutellum comparatively smooth and shining, but with very delicate and minute reticulations which become fainter toward the sides and apex, the disk with about six longitudinal rows of minute setiforous punctures running from the base about two-thirds of the distance to the apex; mesopleura with a fine and delicate shagreening and appearing smooth and polished under low magnification; basal tergite of abdomen comparatively coarsely and transversely lineolate at the middle and reticulate at the sides, the following segments smoothish and shining.

Pubescence of head and thorax abundant but inconspicuous, being very fine, short, and dark colored, erect on the frontovertex, appressed and more or less seriately arranged on the mesoscutum; eyes with rather thick, fine pubescence; scutellum bare at the sides, but with about four rows of fine reclinate hairs on each side of the middle of the disk, which are slightly coarser than those of the mesoscutum, the two median rows on each side reaching from the base about two-thirds of the distance to the apex, the third row or group from the middle consisting of about three hairs arranged in a triangle close to the base, and the fourth row extending from the apex obliquely outward about two-thirds of the distance toward the base; apical margin of scutellum also with a row of six larger erect hairs, inclined slightly forward and the outer ones inwardly; abdomen comparatively bare, the apical tergites with a few scattered hairs of which several on the apical margin are considerably longer than the others.

Coloration black and much less metallic than in the female, with a rather weak greenish luster on the face, and a slight greenish or bluish luster on other parts of the body showing in certain aspects, the pleura and abdomen more shining than the notum but hardly more metallic; antennae blackish, the flagellum appearing somewhat brownish on account of the numerous fine hairs; legs concolorous with the body, the trochanters, knee-joints, tip of front tibiae, and the front tarsi yellowish brown, the hind tarsi brownish, the spur of middle tibiae and the middle tarsi except apical joint yellow; wings hyaline, with brownish veins.

Length of body: (0.834 to) 1.216; length of head: 0.410; width of head: 0.468; width of vertex: 0.212; length of antenna, 0.707; width of mesoscutum: 0.443; length of forewing: 1.058; width of forewing: 0.575 mm.

The following specimens of this species have been examined: 3 females reared in October, 1914, from *Pseudococcus maritimus* (Ehrhorn) from Fresno, California (H. S. Smith), California State Insectary No. 675; 55 females, 23 males reared in November, 1919, from the same host and locality (C. P. Clausen); 1 female reared from an undetermined mealybug, Berkeley, California (E. M. Ehrhorn); and 1 female collected at San Francisco, California, September 16, 1910 (J. C. Bridwell).

Tribe **Mirini**

Acerophagus notativentris (Girault)

Plate 18, figure 1

Pseudaphycus notativentris Girault, Descr. Hym. Chalcid. variorum cum observ., vol. 3, p. 10. Glendale, Maryland, May, 1917.

Acerophagus notativentris Timberlake, Univ. Calif. Publ. Entom., vol. 1, p. 349, 1918.

This species was obtained in numbers from *Pseudococcus maritimus* (Ehrhorn) at Fresno, California, by Clausen. It is not yet known from any other locality, but a very similar species was reared at Columbia, Missouri, from *Pseudococcus jessica* Hollinger on September 29, 1917, by A. H. Hollinger.

Achrysopophagus modestus n. sp.

Female.—Head shaped very nearly as in *A. dactylopii* (Howard) but slightly longer; as seen from in front narrower at the oral margin, the sides from the lower third of the eyes slightly converging nearly straight toward the mouth (slightly bulging out in *dactylopii*); as seen in dorsal view the outline is much less semicircular, being well rounded at the sides but depressed anteriorly; as seen from the side rather thinner fronto-occipitally compared with the length, although there is considerable variation in both species in this respect; eyes slightly less broadly oval, the inner margin posteriorly slightly emarginately depressed so that the outline is less rounded at the dorsal end; frontovertex about four or five times as long as the posterior width, distinctly narrowest just in front of the median ocellus and widening from that point in both directions, the width at the posterior ocelli being one-fourth to one-third greater than the least width (only slightly greater in *dactylopii*); ocelli in an acute-angled triangle, the space between the posterior pair only slightly less than the distance from either to the occipital margin (in *dactylopii* the interspace is about one-half the distance from either to the occipital margin); face and cheeks longer than in *dactylopii*, distinctly more than one-third the total length of the head but considerably less than one-half; scrobal impression and prominence between antennae as in *dactylopii* but narrower, the prominence being as wide as long (distinctly wider than long in *dactylopii*), less uniformly convex, and more ridge-like medially.

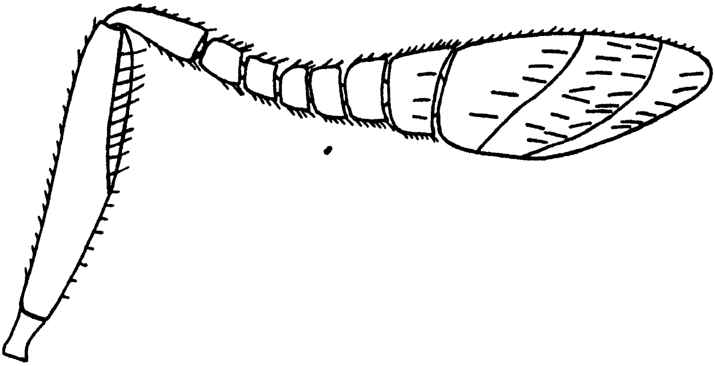

Fig. 5. *Achrysopophagus modestus* n. sp.: antenna of female.

Antennae (fig. 5) inserted slightly closer together than in *dactylopii* but very similar in structure, the scape a little longer and narrower, the club proportionately wider, the hairs on dorsal surface of the last five funicle joints shorter and much stouter, the linear sensoria on the sixth funicle joint and club more numerous and much slenderer; mandibles with three teeth, the ventral or outer one the most acute, the inner one slightly smaller than the others.

Thorax and abdomen practically as in *dactylopii*, but the ovipositor is slightly shorter, being about one-half as long as the abdomen instead of about two-thirds as long. Middle tarsi somewhat less thickened at base; the spur of middle tibiae somewhat slenderer and a little shorter than the first joint of the tarsi. Wings similar but the stigmal vein is much more curved upward and enlarged at apex, the discal setae in the area just beyond and below the apex of the stigmal vein appreciably longer and much more matted.

Upper part of the face above the scrobal impression transversely lineolate with interlacing fine close lines, fingerprint-like, the cheeks with similar fine lines which run obliquely forward; scrobal impression smooth and considerably polished, frontovertex very finely granular; mesoscutum with extremely fine reticulations and very numerous fine setiferous pin-punctures, but the sculpture can be seen only in denuded spots; axillae and scutellum with an extremely fine alutaceous, opaque sculpture; propodeum smooth and polished; mesopleura smoothish and shining but with very delicate microscopic longitudinal reticulations, the propleura and prepectal plates similarly but more coarsely sculptured; basal tergite of abdomen smooth and polished at the base, broadly at the corners and narrowly at the middle, then finely and densely traversely lineolate-reticulate in a concentric band from one posterior corner to the other, thus enclosing a smoothish area at the middle of the apical margin; intermediate tergites smoothish dorsally or with very faint reticulations, the apical tergite with very minute but distinct reticulations all of equal size and shape; reflexed sides or ventral parts of the tergites finely longitudinally lineolate except the first segment and apex of the last; (in *dactylopii* the sculpture is much finer but of the same character, the reticulations and lineolations on the abdomen more restricted).

Eyes with sparse, extremely short, erect hairs; cheeks and lower part of the face with rather sparse white, appressed pubescence, most conspicuous on the antennal prominence and across the oral margin; frontovertex with sparse, very short, fine, inconspicuous hairs; collar of pronotum with a row of stiff, coarse, blackish reflexed hairs, which are much larger than those on other parts of the body; mesoscutum with dense, silvery white, appressed, and scale-like pubescence almost concealing the whole surface; axillae with sparse, short, blackish hairs; scutellum bare at the base but with sparse short hairs on the sides and apex, blackish except in front of the fascicle which is black and of the usual length, the apical margin of the scutellum also with a pair of long, erect, white hairs just behind the fascicle; anterior corners of the propodeum with sparse, scattered, appressed white hairs.

Head about the color of raw sienna (Ridgway), the face and cheeks with a purple luster; pronotum, axillae, tegulae, and pleura raw sienna with a purple luster on the posterior half of the mesopleura; mesoscutum dark greenish black with a weak metallic luster, sometimes slightly yellowish brown on the anterior margin; scutellum cadmium yellow (Ridgeway); propodeum raw sienna on the posterior margin and medially, the remainder brilliant metallic green; abdomen dark greenish, the venter sometimes suffused with yellowish medially, the basal tergite with a variable luster, usually greenish and golden but sometimes brilliant purple. Scape nearly concolorous with the head, with a short fuscous streak on dorsal margin before the apex;

pedicel fuscous with the apex more or less pale; flagellum black, the first three funicle joints dusky yellowish with whitish pubescence, especially on the outer surface. Legs about maize yellow (Ridgway), the front femora slightly infuscated on the upper surface near apex, the tibiae deeper yellowish; middle femora more or less fuscous on apical third especially above, the tibiae fuscous at base and more or less yellowish brown on the apical half; hind femora pale brown but more or less fuscous above on anterior margin, the tibiae fuscous or black; the tarsi all generally a little more yellowish than the base of the legs, the apex of the last joint brown. Exserted part of the ovipositor brownish yellow and provided with very fine whitish hairs. Wings infuscated in a small area at extreme base, otherwise hyaline and bare on the basal third; most of the remainder of disk except apex deeply infuscated, with the basal margin of the cloud straight and transverse, the apical margin strongly rounded; apical sixth of the disk hyaline, with the discal setae in a narrow curved band next to the cloud reduced in size, colorless or even absent in part, but beyond at apex dusky in color; at apex of the postmarginal vein occurs a small hyaline area which sends a narrow hyaline streak vertically toward the center of the disk, the streak being tangent to the apex of the stigmal vein; submarginal vein in most part very pale fuscous, the remainder of the venation darker.

Length of body: (0.895 to) 1.51; length of head: 0.601; width of head: 0.497; width of vertex at posterior ocelli: 0.108; least width of the frons: 0.092; length of face from ocular line to oral margin: 0.214; length of scrobal impression: 0.186; width of scrobal impression: 0.316; distance of scrobal impression from ocular line: 0.012; width of mesoscutum: 0.563; length of ovipositor: 0.295; length of forewing: 1.250; width of forewing: 0.481 mm.

Male.—Unknown.

Described from 13 females (holotype and paratypes) reared during November, 1919, and 1 on January 20, 1920, from *Pseudococcus maritimus* (Ehrhorn) on grape, Fresno, California (C. P. Clausen); 2 females (paratypes) reared from the same host, Riverside, California, November, 1914 (C. P. Clausen), Clausen's no. 35; and 1 female (paratype) reared from an undetermined *Pseudococcus*, Marysville, California (California State Insectary). This species is a secondary parasite of the mealybug, and attacks both *Zarhopalus corvinus* (Girault) and *Anagyrus subalbicornis* (Girault). According to Clausen's observations it is normally thelyotokous in reproduction.

Subprionomitus sp.

The male of what is presumably a new species of the genus *Subprionomitus* Mercet (Fauna Ibérica, Himenópteros, Fam. Encirtidos, pp. 73, 82, 383, Dec., 1921) was also reared by Clausen as a secondary parasite of *Pseudococcus maritimus* (Ehrhorn) at Fresno, California, but, as the classification of the family is properly based almost wholly on the female sex, it is not desirable at the present time to establish a new specific name for this parasite.

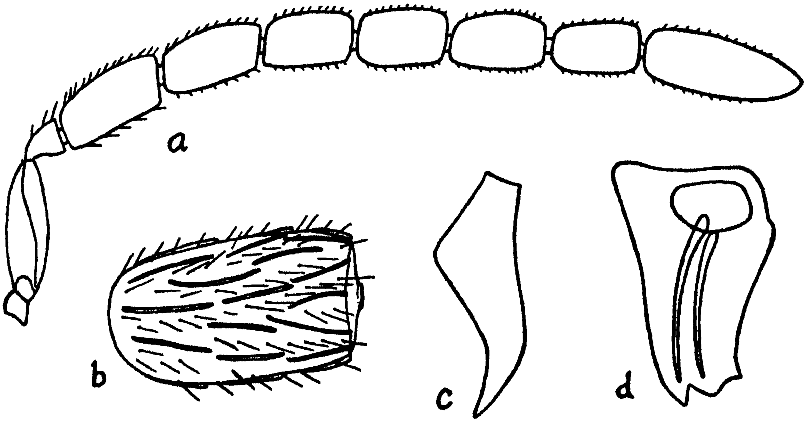

Fig. 6. *Subprionomitus* sp.: *a,* antenna of male; *b,* sixth funicle joint of male antenna, more enlarged; *c,* right mandible of male, ventral view; *d,* same, anterio-dorsal view.

In Mercet's table of the males of the European genera (*loc. cit.,* pp. 73–82), which is the only reliable key to the genera for this sex that has been published, this male runs clearly to *Subprionomitus.* It is very similar to the male of *Microterys* Thomson (genotype, *Encyrtus sylvius* Dalman), but differs in the manner mentioned by Mercet for *Subprionomitus* in having the antennae apparently almost bare and the stigmal and postmarginal veins very short. But in this species the marginal vein is considerably shorter than in the two species described by Mercet, it being about twice as long as thick and only slightly longer than the stigmal. The venation, however, is less stable in the male sex than in the female, and I do not believe that this slight difference has much importance.

The flagellum of the antenna (fig. 6*a*), although appearing bare is really rather densely pubescent, but the setae are so extremely fine and short that they are not easily seen except under high magnification; the six funicle joints and solid club are also provided with very numerous linear sensoria (a feature not found in *Microterys* and not mentioned by Mercet for *Subprionomitus*), arranged in overlapping transverse rows (fig. 6*b*), of which there are about five on the first two funicle joints, four on the following funicle joints, and about six on the club; the upper surface of the scape and pedicel also appear coarsely reticulate at high magnification.

The head is shaped as in *Microterys*, with the frontovertex about a half wider again than long; the rather large ocelli are arranged in a somewhat obtuse angle, with the posterior pair about one-half their own diameter from the eye margin and slightly farther from the occipital margin. The sculpture throughout is similar to species of *Microterys*, the frontovertex being densely granularly shagreened and without pin-punctures.

The general coloration is metallic black with a slight greenish or aeneous luster on the dorsal parts, the face and cheeks rather brilliant bluish green with the scrobes more greenish, mesopleura with a moderately strong bluish luster; antennae dark brown or fuscous with the apical third of the scape yellowish; front and middle legs yellowish white, with the front tibiae slightly brownish, the front tarsi except the basal joint more or less fuscous and the middle coxae concolorous with the body; hind legs fuscous with the trochanters, knee-joints, apex of the tibiae oblique, so that the pale color extends on the lower side nearly to the middle, and basal joint of the tarsi brownish yellow; wings hyaline.

Length of body: (0.749 to) 1.115; length of head: 0.421; width of head: 0.455; thickness of head fronto-occipitally: 0.219; width of frontovertex: 0.219; length of antenna: 1.134; width of mesoscutum: 0.483; length of forewing: 1.110; width of forewing: 0.544 mm.

The material examined includes nine males reared as a secondary parasite of *Pseudococcus maritimus* (Ehrhorn), November, 1919, from Fresno, California (C. P. Clausen), no. 1109. According to Clausen this species is a direct parasite of *Zarhopalus*, *Anagyrus*, and *Acerophagus*.

Family **Signiphoridae**

Thysanus Walker

To the synonymy of this genus as given by Silvestri (Boll. Lab. Zool. Portici, vol. 12, p. 266, 1918) should be added *Neosigniphora* Rust, Entom. News, vol. 24, p. 164, 1913. As Rust's specific name is preoccupied in the genus *Thysanus* by *T. niger* (Ashmead), the new name *Thysanus rusti* is proposed for his *Neosigniphora nigra.*

Silvestri (*loc. cit.*, p. 268, fig. 11, 15816), in redescribing *Thysanus ater* Walker maintains that there are four ring-like funicle joints in the male antennae, as in the female, but there is a possibility of mistake in this as I have found only three funicle joints in the males of several species of *Thysanus* which I have examined.

Thysanus elongatus (Girault)

Plate 19, figure 4

Neosigniphora elongata Girault, Psyche, vol. 23, p. 41, 1916, ♀.

This species was originally described from a single female reared from a Coccid on *Muhlenbergia* at Elk Point, South Dakota. Girault compared it with *Signiphora australica* Girault and thus placed it in the second section of his *nigra* group in his key to the species of Signiphora (Proc. U. S. Nat. Mus., vol. 45, p. 228–229, 1913). The species of this section of the *nigra* group so far as I know them from examination of the types in the National Museum have the middle tibiae more or less clavate, with one large spine at apex opposite the spur and another equally large spine at about the basal third on the dorsal margin as in *Signiphora maxima, pulchra,* and *noacki,* and it is possible that they do not all belong to *Thysanus.*

Specimens of *elongatus* reared by Clausen from *Pseudococcus maritimus* (Ehrhorn) at Fresno, California, were found to agree very well with Girault's description but as the middle tibiae agreed closely with the species of the first section of the *nigra* group in Girault's key, and also in venation but not in the length of the marginal fringe of the forewing, I was doubtful of the identity of the insect until Mr. A. B. Gahan at my request kindly compared specimens with the type of *elongatus.* Gahan wrote me as follows:

> Have compared your specimens of the *Thysanus* from *Pseudococcus maritimus* with *Neosigniphora elongata* Girault and believe they are the same species. They agree perfectly as far as I can tell except that the type has slightly narrower forewings and the spines on the middle tibiae appear to be very slightly shorter, though of the same type and in the same position. While the blade of the wing appears to be a little narrower in the type than in your specimens the marginal cilia are practically of the same length, thus making the proportions a little different. There appears to be a slight variation in the width of the wing-blades in the three specimens sent by you and I believe there is no reason to consider the type anything more than a specimen of the same species in which the wings are not fully developed.

The following notes on these Californian specimens will serve to supplement Girault's description and to make known the male: .

Female.—Black, but the frontovertex and mesonotum with a distinct greenish luster, the legs and antennae usually black but in small specimens sometimes distinctly brownish, the tarsi always yellowish but becoming dusky at apex; wings smoky but nearly hyaline on the basal fourth and with a clear cross-band of irregular width opposite the stigmal vein, the proximal margin of the band being strongly sinuate, the apex of the wing not so deeply stained as the area beneath the marginal vein.

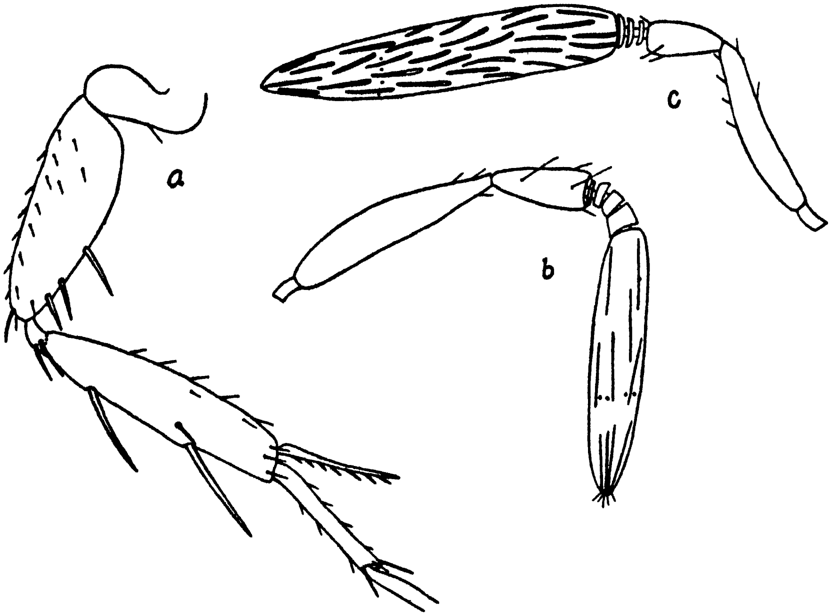

Fig. 7. *Thysanus elongatus* (Girault): *a*, middle leg of female; *b*, antenna of female; *c*, antenna of male.

General form distinctly more elongate than in *Thysanus niger* or *dactylopii* (Ashmead) or about three times as long as the greatest width of the body; ovipositor slightly protruded; antenna and middle leg as in figures 7*a* and 7*b*; forewings as compared with *niger* very narrow, the marginal cilia at apex about equal to one-third the width of the disk, the longest cilia rather less than one-half the width; the venation practically as in *niger.*

Sculpture at magnification of 65 diameters much more evident than in related species, the frontovertex being smooth and polished but with rather numerous fine scattered pin-punctures; the mesonotum finely and transversely lineolate-reticulate and with a few minute punctures which are finer and sparser than those on the frontovertex; the abdomen finely reticulate above.

Length of body: (0.497 to 0.989) 0.813; greatest width of body across abdomen: 0.297; length of antenna: 0.485; length and width of scape excluding radicle joint: 0.160 by 0.035; length and width of pedicel: 0.075 by 0.033; length and width of club: 0.193 by 0.045; length and width of the forewing: 0.592 by 0.219; length and width of hindwing: 0.575 by 0.158; length of exserted part of ovipositor: 0.070 mm.

Male.—Very similar to the female but broader in proportion to the length of the body; the middle legs similar but with the tibiae considerably slenderer; antenna as in figure 7*c*, the funicle being composed of three very small ring-joints.

Length of body: (0.483 to) 0.636; greatest width of body: 0.271; length of antenna: 0.504; length and width of club: 0.271 by 0.054; length and width of forewing: 0.566 by 0.214 mm.

The following material has been examined: 14 females, 7 males reared by Clausen from *Pseudococcus maritimus* (Ehrhorn), Fresno, California, in November, 1919, and according to his observations directly parasitic on *Zarhopalus, Acerophagus, Anagyrus, Pseudleptomatix,* and occasionally as a tertiary parasite on *Tetrastichus* and *Achrysopophagus.*

Family **Eulophidae**

Subfamily **Tetrastichinae**

Tetrastichus blepyri Ashmead

Tetrastichus blepyri Ashmead, Can. Entom., vol. 34, p. 302, 1902, ♀.

This species is a common hyperparasite of Coccidae in the southwestern states, and my thanks are due to Mr. A. B. Gahan for comparison of material with Ashmead's types. It was originally described in the female sex from specimens reared by T. D. A. Cockerell from *Phenacoccus cevalliae* Cockerell, at Rosewell, New Mexico, and secondary on *Blepyrus phenacocci* Ashmead, now to be known as *Chalcaspis phenacocci* (Ashmead).

It is interesting to note the position of this species in the various classifications of the Tetrastichinae that have been proposed. It is a typical *Geniocerus* both according to the original definition of Ratzeburg and the redefinition of Kourdumoff. In Ashmead's classification it would naturally fall in *Tetrastichodes* and in Girault's system it would go in *Neotetrastichodes*, but these two genera have identical characters, viz., four ring-joints in the antennal funicle and no median groove on the mesoscutum.

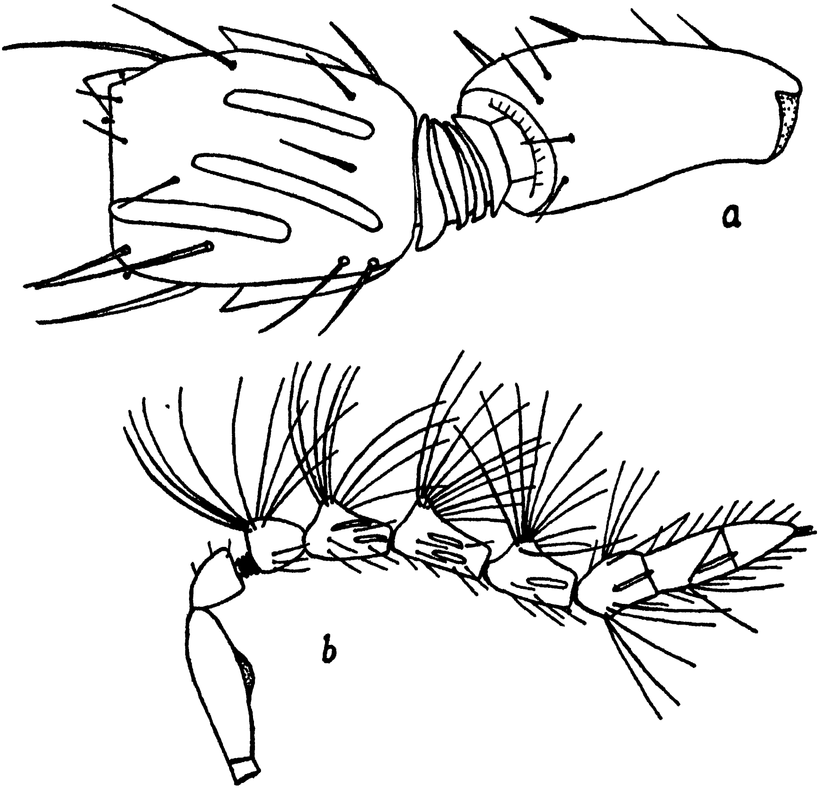

Fig. 8. *Tetrastichus blepyri* Ashmead: *a*, antenna of female, showing pedicel, ring-joints, and first funicle joint; *b*, antenna of male.

The principal characters of this species are as follows:

Female.—Head and body black with a dark greenish blue luster; scape yellowish, the pedicel fuscous or blackish but sometimes more or less yellowish especially at apex on the underside, the flagellum fuscous; coxae and femora concolorous with body, the knee-joints, tibiae, and tarsi yellow with the apex of the tarsi infuscated, or sometimes the tibiae especially the hind pair more or less brownish except at apex; tegulae brownish, the eyes dark red.

Clypeal margin minutely serrate; scape rather short and slightly fusiform, sulcate beneath on the apical half; pedicel nearly twice as long as thick and about as long as the first funicle joint; the four ring-joints (fig. *8a*) very short, the two middle ones shorter than the other two, first funicle joint about a half longer again than thick, the next two proportionately a little thicker as they increase slightly in thickness distad, but there is considerable variation: small specimens having the flagellum slenderer; club about a fifth shorter than the funicle joints combined, its apical joint considerably shorter than the other two and with a short cylindrical terminal nipple; flagellum provided with rather numerous coarse linear projecting sensoria, sparser in small specimens, and with rather short bristle-like hairs which for the most part are nearly colorless.

Mesoscutum without a median groove; the median and lateral paired grooves of scutellum distinct; middle lobe of mesoscutum with a row of about five or six fine setae on each side close to the parapsidal furrow; scutellum with two pairs of somewhat longer setae inserted just laterad of the median grooves at the middle of the disk and near the apex; submarginal vein of forewing provided with about five or six setae. Abdomen strongly depressed above, oval in outline, slightly wider and longer than the thorax; ovipositor slightly protruded.

Sculpture of the usual Tetrastichine type but very fine and delicate; pronotum finely rugose and considerably more coarsely shagreened than the mesoscutum; propodeum smooth and with a median carina; abdomen above with very fine reticulations.

Length of body (1.02 to) 1.58; length and width of head: 0.445 by 0.507; length of antenna: 0.716; width of mesoscutum: 0.493; length and width of forewing: 1.381 by 0.674; length of exserted part of ovipositor: 0.082 mm.

Male.—Resembling the female, but the abdomen considerably smaller, it being somewhat narrower and shorter than the thorax; the antennae as in figure *8b*, there being three very short ring-joints and verticils of long hairs near the base of each of the funicle joints and on the basal joint of the club; the cicatrix or sense organ on the ventral margin of the scape is moderately large and placed near the middle. Coloration as in the female, but in individuals with brown tibiae the tarsi also may be largely brown except at base.

Length of body: (0.794 to 1.315) 1.296; length and width of head: 0.375 by 0.438; length of antenna: 0.813; width of mesoscutum: 0.415; length and width of forewing: 0.242 by 0.603 mm.

The following material of this species has been examined: 2 females, 2 males from *Pseudococcus maritimus* (Ehrhorn), Fresno, California, November, 1919 (C. P. Clausen), and parasitic on

Zarhopalus, Anagyrus, and *Pseudleptomasti*[illegible]1 female from *Pseudococcus maritimus* (Ehrhorn) on palm, Ri[illegible], California, October, 1914 (C. P. Clausen), and parasitic on *Chrysoplatycerus splendens* (Howard); 7 females, 17 males from *Physokermes insignicola* (Craw), Santa Maria, California, November, 1911 to April, 1912 (W. C. Wylie), and parasitic on *Aphycus physokermis* Timberlake and presumably also on *Microterys mazzinini* Girault and *Coccophagus albicoxa* Howard; 2 females from *Erium lichtensioides* (Cockerell), Santa Barbara, California, August 2, 1911 (Timberlake), and presumably parasitic on an *Anagyrus* sp.; 1 female from *Eulecaninus* sp. on *Ceanothus,* Mt. San Antonio, California, about 6000 feet elevation, July 15, 1911 (Timberlake), and probably parasitic on *Cocophagus lecanii* (Fitch) or *Pachyneuron californicum* Girault; 1 female, 1 male from *Eulecanium corni* (Bouché) on *Heteromeles,* Berkeley, California, April 21, 1911 (Timberlake), and probably parasitic on *Blastothrix longipennis* Howard or *Coccophagus lecanii* (Fitch); 1 male from *Pseudococcus adenostomae* Ferris, San Diego, California, September 10, 1920 (G. F. Ferris), and presumably parasitic on *Chrysoplatycerus ferrisi* Timberlake; 1 female from *Saissetia oleae* (Bernard), Santa Paula, California, May 5, 1921 (E. O. Essig), and presumably parasitic on *Aphycus lounsburyi* Howard; 8 females, 1 male, September, 1921 (H. Compere), data otherwise as for preceding specimen; 4 females, 9 males from *Pulvinaria bigeloviae* (Cockerell), Murray, Utah, August, 1913, and June, 1914 (Timberlake), and parasitic on a *Microterys* sp. and perhaps on a *Coccophagus* sp.; 1 female, 1 male from an undetermined Coccid, Arizona, 1906 (A. Koebele); 1 female, 1 male probably from a Coccid, Mexico (A. Koebele), no. 802.

PART II

BIOLOGICAL STUDIES AND LIFE HISTORIES

BY

CURTIS P. CLAUSEN

INTRODUCTION

In recent years the mealybugs (Genus *Pseudococcus*) have come to assume a position of importance among the insect pests of California, particularly those forms infesting the grape in the San Joaquin Valley, the pear in the Santa Clara Valley, and the citrus in Southern California. The damage caused by the attacks of these insects has been considerable, and all possible means of control have been employed. The great difficulties encountered in mechanical control led naturally to an investigation of the possibilities of the biological method of effecting control, which provides for the utilization of the natural enemies, both parasitic and predacious. The efforts of the Insectary Division of the State Department of Agriculture (Smith and Armitage, 1920) have resulted in a marked degree of success in the use of its natural enemies against the common mealybug (*Pseudococcus citri* Risso) in the citrus orchards of Southern California. The credit is due largely to the imported coccinellid *Cryptolaemus montrouzieri* Mulsant, together with the native coccinellids, chrysopids, hemerobiids, and a dipterous predator (*Leucopis bella* Loew). All of these had been present for many years, but adverse conditions prevented effective results. These adverse conditions were remedied or obviated in the case of *Cryptolaemus montrouzieri* Mulsant, and the added impetus thus given the species resulted in practical control.

The success which attended the work on the common mealybug naturally resulted in similar efforts being made to control other injurious species. The well known Baker's mealybug (*P. maritimus* Ehrhorn), a species endemic to California, is an omnivorous feeder and occasionally becomes numerous enough in the citrus orchards of Southern California to produce injury to the crop. In the southern part of the state this species has only one parasite sufficiently numerous to be noticeable, while in the San Francisco Bay region none has thus far been recorded. In the San Joaquin Valley a form identical with the common mealybug in general appearance and morphological structure is a very serious pest of the grape, and, curiously enough, is found upon this host almost to the exclusion of all others. Citrus trees and various ornamental plants and shrubs which are common hosts in Southern California, though found growing immediately adjacent to heavily infested vines, were not attacked. Upon this form was found a series of five primary parasites which at times effect a total parasitism of over 90 per cent. Repeated efforts by the writer during 1914–15 to breed these parasites upon the Southern California form resulted negatively, as did also a series of experiments upon the interchangeability of host plants. These results corresponded to those secured by Smith at the California State Insectary, and led to the belief that this San Joaquin Valley form was a so-called physiological race if not a distinct species. Taxonomists have repeatedly affirmed the individuals to be the same species; but when we consider the difficulties in the classification of this group, and the lack of fixed standards, there is very frequently room for doubt as to the correctness of the determinations. The occurrence of very heavy parasitism by a number of species in one region, of occasional different species in another section, and the complete absence of the species in a third, indicated possibly a differentiation which has escaped the attention of the systematists. The problem as dealt with in this paper concerns itself largely with the biology and interrelations of the parasites above referred to, including breeding experiments upon the various forms, and these data serve as the basis for a conclusion on the points under consideration. These investigations were carried on intermittently from 1915 to 1920.

COMPARATIVE EXPERIMENTS UPON REGIONAL FORMS OF PSEUDOCOCCUS

The three forms under consideration were, first, the form of Southern California, an omnivorous feeder, occasionally of importance as a citrus pest, with three parasites, none of any consequence in control; second, the form of the San Francisco Bay region, an omnivorous feeder, at times a serious pest in pear orchards, with no parasites whatsoever; and third, the form of the San Joaquin Valley, a pest of the grape, largely restricted to it as a host, with a series of five parasites which frequently effect a parasitism in excess of 90 per cent.

Taxonomic characters.—A detailed study of all known morphological characters failed to reveal any means of differentiating the three forms. A recent redescription of the species, in which a number of new characters are mentioned, is given in a recent paper by Ferris (1918).

Life history.—The forms from the San Francisco Bay region and from Southern California are identical in their life histories. Breeding is continuous throughout the year though the numbers are greatly reduced during the winter. All stages may be found at this time though the adult female and eggs predominate. According to Nougaret (1918) the San Joaquin Valley form has two distinct generations each year, while the winter is passed in the early larval stages in crevices and under the bark of the twigs and trunk. This apparent discrepancy in the life history is not altogether conclusive because of the fact that the host plant is deciduous, while those of the other two forms largely retain their foliage throughout the year. This naturally would have some effect upon the duration of feeding in the latter part of the season and consequently also upon the stage of development attained by the insect. The form upon the grape has adapted itself admirably to its host, and a life history as given is essential to continued development upon that plant. The long period of hibernation which has been developed persists even under conditions which eliminate the necessity for it. The mealybugs in general are highly adaptive with respect to their life history, and during a long period of time may produce a strain well suited to new conditions.

Host plants.—The forms from Southern California and the San Francisco Bay region are both general feeders upon practically all types of plants and may be found upon citrus trees whenever present. The San Joaquin Valley form, as has been noted, feeds almost exclusively upon the grape, even though citrus trees and various ornamentals are present in the immediate vicinity. Laboratory experiments indicate that the San Joaquin Valley form will develop only indifferently upon green oranges or lemons, though all forms will breed satisfactorily upon potato sprouts, a neutral medium acceptable to nearly all species of the genus.

Parasites.—In the experiments upon the parasites with regard to their adaptability to the different forms the following species were used: *Chrysoplatycerus splendens* (Howard) of the Southern California form, *Acerophagus notativentris* (Girault), *Zarhopalus corvinus* (Girault), and *Anagyrus subalbicornis* (Girault), of the San Joaquin Valley form. During 1915 a short series of experiments on the interchangeability of hosts of these parasites had resulted negatively, but were not conclusive. In 1919 these tests were extended in scope and number, and resulted somewhat differently. *C. splendens* was found to be able to reproduce quite freely upon the two forms on which it does not normally exist. In the form of the San Francisco Bay region a partial immunity to *Z. corvinus* was found to occur. A large series of dissections revealed the fact that about 19 per cent of the individuals that had been subjected to oviposition were able to destroy the parasitic larva before it reached maturity. A portion of this percentage, however, may be attributed to natural mortality as distinguished from the effect of the defensive reactions of the host. Dissections of field material of this form also showed many larvae and adults containing the remains, in various stages, of parasite larvae which had not been able to mature. *A. notativentris* and *A. subalbicornis* were able to reach maturity on either form, and without any appreciable difference in mortality in the early stages. In the light of these results it is difficult to explain the failure of the species to reproduce in the first series of experiments, though it is possible that the laboratory conditions provided and the type of breeding cages used were not conducive to oviposition.

The existence of three species of parasites in Southern California, of five others in the San Joaquin Valley, and of none in the San Francisco Bay region may, on the basis of the foregoing experiments, be attributed largely to ecological factors. Each of them is much more restricted in its habitat than are the host forms, which are able to maintain themselves under very diverse conditions. All being endemic to California, the question of artificial limitation, such as occurs in the case of introduced species, does not enter into the problem.

SUMMARY

1. The three forms are morphologically identical, though the form from the San Joaquin Valley may be termed a physiological race, in the accepted sense of that term.
2. The seasonal history of the San Joaquin Valley form may be considered as a special adaptation to its particular host.
3. The various parasites will, under laboratory conditions, breed freely upon all the three forms. Their restricted habitat is to be attributed to ecological factors.

INTERRELATIONS OF THE PARASITES*

Rearing records from *Pseudococcus maritimus* (Ehrhorn) material collected in various parts of the state show a series of eight primary and four secondary parasites from this host. They are as follows:

PRIMARY PARASITES
- Acerophagus notativentris (Girault)
- Anagyrus clauseni Timberlake
- Anagyrus subalbicornis (Girault)
- Chrysoplatycerus splendens (Howard)
- Pseudaphycus angelicus (Howard)
- Pseudleptomastix squammulata Girault
- Zarhopalus corvinus (Girault)
- Zarhopalus sheldoni Ashmead

HYPERPARASITES
- Achrysopophagus modestus Timberlake
- Tetrastichus blepyri Ashmead
- Thysanus elongatus (Girault)
- Subprionomitus sp.

Of this series three have proved to be new species, and two of them, *Anagyrus clauseni* and *Achrysopophagus modestus,* are described by P. H. Timberlake in the first part of this paper. The third, *Subprionomitus* sp., has not been described because of the fact that only males have thus far been obtained.

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* The technical terms designating various relationships among the parasites are used in the sense defined by Smith (1916).

Of the primary parasites listed above, all belong to the family Encyrtidae, and are endoparasitic within the host in all the various stages of its development. Of the hyperparasites, the signiphorid, *Thysanus elongatus* (Girault), and the tetrastichine, *Tetrastichus blepyri* Ashmead, are external feeders, while the encyrtid, *Achrysopophagus modestus* Timberlake, develops internally.

The interrelations of these species have been determined in so far as numbers would permit, and are here given in tabular form.

HOST: Pseudococcus maritimus Ehrhorn

PARASITES

PRIMARY	SECONDARY	TERTIARY
Acerophagus notativentris (Girault)	Thysanus elongatus (Girault)	
	Subprionomitus sp.	
Anagyrus clauseni Timberlake		
Anagyrus subalbicornis (Girault)	Achrysopophagus modestus Timberlake	Thysanus elongatus (Girault)
	Thysanus elongatus (Girault)	
	Tetrastichus blepyri Ashmead	Thysanus elongatus (Girault)
	Subprionomitus sp.	
Chrysoplatycerus splendens (Howard)	Tetrastichus blepyri Ashmead	
Pseudleptomastix squammulata Girault	Tetrastichus blepyri Ashmead	
	Thysanus elongatus (Girault)	
Pseudaphycus angelicus (Howard)		
Zarhopalus corvinus (Girault)	Achrysopophagus modestus Timberlake	
	Thysanus elongatus (Girault)	
	Tetrastichus blepyri Ashmead	
	Subprionomitus sp.	
Zarhopalus sheldoni Ashmead		

A detailed discussion of the various phases of this hyperparasitism will be given in the following pages in connection with the biology of the individual species. All twelve of the parasites listed above are endemic to California and, with a few exceptions, have not thus far been recorded elsewhere.

REARING RECORDS.—In Southern California the parasitism of *Pseudococcus maritimus* (Ehrhorn) is usually so slight that only occasionally can specimens be obtained. But at Fresno parasitized material was abundant, and collections were made at that place during the month of September to November for the purpose of getting full data bearing upon the relative numerical abundance of the various species, the sex ratio, the manner and time of emergence, etc. During these months practically all forms were present in the condition or stage in which they would pass the winter, though some adults were observed. A total of 1080 parasitized mealybugs in all stages were isolated in gelatin capsules for individual rearing. Of this number 984 eventually yielded adult parasites, or at least matured sufficiently to permit of determination by dissection. In the case of the hyperparasites, the primary host was determined by various means, some being readily distinguished by the form of the tunica, and others by the remnants of the various stages remaining after the completion of development of the hyperparasites. From the one thousand and eighty hosts, nine species of parasites were reared, five being primary and four secondary. In number of individuals there were 1285 of the former and 515 of the latter. The detailed results are here given in tabular form:

HOST: Pseudococcus maritimus (Ehrhorn)

Fresno, California. September–November, 1919'

PARASITES	Males	Females	Total	Sex ratio	No of hosts	Average per host
Acerophagus notativentris (Girault)	180	430	614	1–2.4	78	7.9
Zarhopalus corvinus (Girault)	56	294	350	1–5.3	350	1.0
Anagyrus subalbicornis (Girault)	2	278	280	1–139	280	1.0
Pseudleptomastix squammulata Girault	3	37	40	1–12.	40	1.0
Anagyrus clauseni Timberlake	0	1	1		1	1.0
		Total	1285		749	

HYPERPARASITES	Males	Females	Total	Sex ratio	No of hosts	Average per host
Thysanus elongatus (Girault)	74	362	436	1–4.9	156	2.8
Achrysopophagus modestus Timberlake	0	52	52		152	1.0
Subprionomitus sp.	24		24		24	1.0
Tetrastichus blepyri Ashmead	0	3	3		3	1.0
		Total	515		235	

At the time this material was isolated all parasites were sufficiently advanced to have caused the death of the host; in other words, the primary parasites had reached at least the advanced larval stage. As these collections were made late in the season the figures given represent the approximate relative numbers which are carried over to the following season. Most of the primaries emerge very early in the spring and are therefore not subjected to additional parasitism at that time, while others, notably *Pseudleptomastix squammulata* Girault, are called upon to bear an early spring generation of secondaries in addition to those of the previous fall because of the very late time of emergence. This may be one of the most important factors responsible for the relative scarcity of the species.

A study of the time of emergence of the different species is of interest as bearing upon the order of their emergence in the spring and upon their behavior under various conditions of temperature and humidity. The material collected at Fresno, November 11, 1919, was isolated and kept in the laboratory at room temperature ranging from 20–25° C. The first species to emerge was *Zarhopalus corvinus* (Girault), all of which appeared within fifteen days; all *Acerophagus notativentris* (Girault) emerged in twenty-four days, while the first *Anagyrus subalbicornis* (Girault) emerged on the fifteenth day and regularly thereafter until the end of December. Seventy-five individuals appeared during the eight weeks in which the material was under observation. On December 28 the remaining material was dissected and twenty-four additional live pupae found. During this entire period not a single *Pseudleptomastix squammulata* Girault appeared, yet on dissection twenty live pupae were found present in the tunicae. This pronounced dormant period was even more strongly shown in a quantity of material previously collected and isolated on October 2, and kept under the same conditions as the foregoing series until December 29, on which date they were placed in an incubator at a constant temperature of 31° C. Three individuals emerged on January 5, 9, and 11, respectively. On the 17th the remainder were dissected and found to be alive and in the advanced pupal stage. This great prolongation of the dormant season indicated that the species emerges very late in the spring, at about the time the host larvae are in the third instar.

In the case of the hyperparasites, *Thysanus elongatus* (Girault) emerged rather irregularly, from fifteen to thirty days from the time of collection. It is thus apparent that an additional generation is possible in the spring upon the over-wintering *Pseudleptomastix squammulata* Girault and upon a considerable proportion of *Anagyrus subalbicornis* (Girault). This is a rather unusual condition, as in most cases the time of emergence of the adult secondaries is later than that of unparasitized individuals of the host species. As *Thysanus elongatus* (Girault) is by far the most abundant numerically, it is evident that this second generation upon the over-wintering individuals of the host exerts a strong influence upon their numerical increase at the most important period of the season.

BREEDING METHODS.—In order to insure a constant supply of host material for laboratory breeding experiments, and not to be dependent upon fluctuating infestations in the field, the mealybug was propagated upon potato sprouts in the greenhouse after the manner developed at the California State Insectary (Branigan, 1916). An ample supply of all stages of the host was thus available at all times.

In making detailed life histories of the parasites the most satisfactory and convenient method was found to be the use of fresh potato sprouts about three-fourths of an inch long, detached from the tuber, and placed in gelatin capsules which in turn were inclosed within glass vials. The capsules readily absorbed any surplus moisture given off, while the glass vial prevented the desiccation which would otherwise normally occur. Under these conditions the sprouts remain sufficiently succulent for feeding purposes for about two weeks, and as the mealybug larvae feed only eight to twelve days after being parasitized, sufficient food material is available for the entire period without the necessity of a change and consequent handling with possible injury to the material. This method facilitated the work greatly by eliminating the necessity for cages upon growing plants and because of the great ease and convenience in manipulation and observation.

In the case of *Zarhopalus corvinus* (Girault) and *Chrysoplatycerus splendens* (Howard), which parasitize practically all the later stages of the host, the use of potato sprouts for feeding purposes was dispensed with altogether by the judicious selection of mealybugs in the proper stage of development. This made possible individual life histories of the parasites in capsules or similar containers without food of any sort. The mature gravid female mealybugs do not require food during the period of oviposition nor for several days prior to that time, as is shown by the fact that in the field a considerable proportion of the females leaves the feeding places shortly before the commencement of oviposition and seeks out secluded crevices within which to lay the eggs; in such places there is no feeding surface available.

When observation by binocular was necessary upon the manner of oviposition of the smaller parasites, etc., a satisfactory cage was constructed of two microscope slides bound with adhesive paper, between which a small infested potato sprout was placed. This cage was very convenient for the purpose and had a depth only slightly in excess of that of the field of vision of the binocular. With the hyperparasite *Thysanus elongatus* (Girault) the entire process of oviposition and the complete development of the larva were observed under the low power of a compound microscope by the use of a cage made of a drop culture slide and a cover-glass. A portion of the tunica containing the pupa of the primary parasite was first removed and this, together with the adult female *Thysanus,* placed in the depression of the culture slide, after which the cover-glass was placed in position and fastened with a small drop of vaseline. The interior of the tunica and the pupa which it contained were thus clearly visible at all times and the female parasite was able to move about and to oviposit freely.

Observations on the development of the embryo can very readily be made by dissecting out the freshly deposited eggs from the host and placing them in a normal or indifferent fluid. Either a normal saline (.75 per cent) or Ringer's solution may be used. It has been found that the larvae of many species whose eggs are free-floating in the body fluids of their hosts will fully mature, and occasionally, though not often, be able to hatch before the death of the host. In the second of the above-mentioned solutions many free-floating larvae will live for several days, a fact which greatly facilitates close examination of the larvae in the living condition.

For the feeding of the adult parasites in captivity, a weak solution of either sugar or honey was satisfactory. The parasites were confined in vials in which had been placed a folded strip of paper to serve as a surface upon which they could rest. Most species preferred paper to glass for this purpose. The more minute species were fed by means of a glass capillary tube about two and one-half inches in length inserted through the cork, and sufficiently enlarged at its outer end to contain several drops of the solution. By placing this outer end in the mouth and blowing through it, a drop of the required size can be forced out of the other end and placed at any desired position in the vial without removing the cork. It is desirable to change vials and paper strips about twice monthly, but otherwise it is unnecessary to open the containers. This fact becomes very important when records of oviposition are being made, as it largely eliminates the possibility of escape of some of the very active species. With certain forms, such as *Anagyrus,* as well as with the males of many of the more delicate chalcids, the least moisture upon the surface of the glass quickly results in the fouling of the antennae and the consequent death of the individuals. It is therefore not desirable to put the sugar solution in any position where the parasites may entangle themselves in it. With these species a somewhat larger capillary tube, having an inner diameter of about .25 mm. should be used, and the parasites permitted to feed directly from it. In a feeding tube of this size the vials should always lie flat, as otherwise the solution will drain out, the capillary attachment not being sufficient to hold it in the tube. Certain other parasites, such as the Eupelmidae, are so very active and jump about with such force and frequency, that they also must be fed in the same way.

PARTHENOGENESIS

Parthenogenetic reproduction is a very common phenomenon in a great number of the parasitic Hymenoptera, possibly among all of the Chalcidoidea, and occurs more or less frequently in all the species considered in this paper. The resulting progeny in the case of *Zarhopalus corvinus* (Girault), *Chrysoplatycerus splendens* (Howard), *Acerophagus notativentris* (Girault), *Thysanus elongatus* (Girault), and *Tetrastichus blepyri* Ashmead were all males, while in *Achrysopophagus modestus* Timberlake females were produced generation after generation without the intervention of the male. In *Pseudleptomastix squammulata* Girault and *Anagyrus subalbicornis* (Girault) the male is found only occasionally and not in sufficient numbers to permit of the general fertilization of the females; reproduction is therefore generally parthenogenetic. It is evident, therefore, that frequent or general reproduction in this way among those species which are thelyotokous would result in a much greater rate of increase than if a portion of the progeny were males. This may be illustrated by calculating the possible rate of increase of *Achrysopophagus modestus* Timberlake for one year, allowing five generations of fifty each. One female reproducing parthenogenetically for this period of time would give rise to 312,500,000 individuals, providing there were no mortality. If, however, a female were fertilized and gave rise to progeny of both sexes in the ratio of one to three, the total number of females at the end of the year would be 74,200,000. This of course is purely theoretical, yet it has a practical bearing upon the practices and possibilities of parasite introduction and colonization. In case of the introduction of a species which is thelyotokous into a new locality, it would be decidedly advantageous to eliminate the males, as illustrated above. No evidence has been produced to show that the continued absence of the male contributes in any way to a weakening of the race. In certain cases the advantage is offset by a reduction in the average number of progeny because of a lack of fertilization. This has been demonstrated in several cases but is not known to be a general condition. As a matter of fact, in those species which are able to produce females without fertilization the male is very seldom present under natural conditions.

THE SEX RATIO.—A study of the relative proportions of the sexes produced by the various species under field conditions during the latter part of the year reveals a preponderance of females in all species. The ratio of males to females in *Acerophagus notativentris* (Girault) was 1 to 2.4, in *Zarhopalus corvinus* (Girault) 1 to 5.3, in *Pseudleptomastix squammulata* Girault 1 to 12, and in *Anagyrus subalbicornis* (Girault) 1 to 139. Of the fifty-two individuals of *Achrysopophagus modestus* Timberlake reared during the past season all have been females, indicating that the species is normally thelyotokous. In *Tetrastichus blepyri* Ashmead the three individuals reared were females, though from these a generation of males were produced. In the case of species having the sexes nearly equal in number all were found to be arrhenotokous. This is to be expected, as with a relatively large proportion of males the chance of fertilization of the females is very good, and the resulting progeny are presumably mostly females. However, a portion of the eggs are probably laid previous to fertilization, and these serve to maintain the number of the males.

ECONOMIC IMPORTANCE OF THE PARASITES OF P. MARITIMUS (EHRHORN)

While *Pseudococcus maritimus* (Ehrhorn) is found generally throughout the state and under very diverse conditions, its parasites are much more restricted in their habitat. As previously stated, not one has been found in the San Francisco Bay region, while in Southern California are found *Chrysoplatycerus splendens* (Howard), *Zarhopalus sheldoni* Ashmead, and *Pseudaphycus angelicus* (Howard), none of which is of any consequence whatever. In the section of the San Joaquin Valley where the host is a very serious pest of the grape, we find *Acerophagus notativentris* (Girault), *Zarhopalus corvinus* (Girault), and *Anagyrus subalbicornis* (Girault) in large numbers, while *Pseudleptomastix squammulata* Girault may occasionally be numerous.

During the late summer and fall of 1919 the parasitism in the field exceeded 90 per cent, though this is greater than in normal years. The economic value of this degree of parasitism is problematical because of the fact that the damage by the insect is due not in any way to injury from feeding upon the foliage or stems but solely to the deposition of honey-dew upon the fruit, rendering it unfit for sale. Thus in the case of a heavy infestation a reduction of 90 per cent in numbers would be of little or no value. The only possible benefit that could accrue would be a reduction in the number surviving the winter, thus delaying reinfestation in the spring. In this connection there comes into play the natural laws governing the interrelations of the host with its parasites and hyperparasites. The 1919 season having been one of unusual abundance of primary parasites it was to be expected that the hyperparasites would increase in even greater proportions. This was found to be true, as from a given quantity of material collected, 29 per cent of all which emerged were secondary parasites, mainly of *Zarhopalus corvinus* (Girault) and *Anagyrus subalbicornis* (Girault). A decline in the abundance of these two species was therefore to be expected during the following season.

The possibilities of natural control during a season following one of great parasite development such as that of 1919 have not been determined. In the fall of that year the greater quantity of the parasitized material was to be found on the fallen leaves under the vines. In one instance all such dead foliage, loose bark, etc., was collected from under a single vine and isolated for the emergence of the parasites. From this material 547 primary parasites were reared. If only a small proportion of these could survive the winter the development in the spring of a large percentage of the over-wintering host larvae would be prevented, as they are relatively few in number. But these dead leaves decay and are covered with sand or blown away, so that ultimately probably only a fraction of one per cent of the parasites survive the winter. It has not been possible to investigate this point in the field on a scale large enough to give reliable results.

The latest devised method of control of this grape pest (Neugaret, 1918) provides for the fumigation of the vines with sulfur during the dormant season. As the parasites at this time are in the advanced larval and pupal stages, it is probable that the mortality rate will exceed that of the host, in which case the result will be the practical eradication of the parasites. However, if this method effectively controls the pest the parasites naturally need not be considered.

LIFE HISTORIES

Zarhopalus corvinus (Girault)

Plate 18, figure 1

Of the seven species of primary parasites thus far reared from *Pseudococcus maritimus* (Ehrhorn) in California, *Zarhopalus corvinus* (Girault) is by far the most important. While in numbers it is exceeded by *Acerophagus notativentris* (Girault) its effectiveness, when measured by the aggregate number of hosts destroyed, is much greater. It is limited strictly to *P. maritimus* (Ehrhorn) in the San Joaquin Valley, and has not been reared from this host in the colder coastal regions.

LIFE HISTORY

The egg.—The ovarian egg is a peculiar body consisting of two parts, the first, or egg proper, being broadly oval in form, .13 mm. in length, and the contents white and granular in appearance when dissected out in a saline solution. This main body is connected by a short slender stalk to a much smaller lemon-shaped body on which the micropyle is visible as a small projection on the distal end. During the process of oviposition this smaller body disappears, the contents having been forced into the egg proper. The only evidence of its existence now remaining is a small irregular protuberance, and even this is in some cases not visible. The egg is now approximately .20 mm. in length and free-floating within the body of the host. It increases slightly in size and gradually becomes darker in color during the development of the embryo. When mature the embryo is found curled up within the egg and, in its efforts to extend itself, it ruptures the chorion and escapes into the body of the host.

The larva.—The newly hatched larva is .30 mm. in length, white in color, and with the cephalic segments set off from the remainder of the body by a distinct suture. The segmentation is distinct, and the last segment is apparently prolonged into a tail-like appendage which is bent back at an angle of about 30 degrees from the axis of the body. As far as could be determined the usual holopneustic type of tracheal system is not evident, and it is probable that the tail structure serves as a blood gill after the manner shown by Timberlake (1912) in the case of the first instar of *Limnerium validum* (Cresson). This structure persists through the second instar though relatively reduced in size. Feeding during the period immediately following hatching is apparently restricted to the body fluids of the host, and the digestive tract soon becomes distinctly darkened. As the larva develops, however, it feeds indiscriminately upon the body tissues until eventually the entire contents of the host are consumed.

The fully developed larva is white in color, .80 to 1.75 mm. in length, and with the dark digestive tract showing distinctly through the body tissues. In this stage may be seen the eight pairs of spiracles at the side of the body, each connecting by a short tracheal tube with the main lateral trunk. The death of the host takes place just prior to pupation and the remaining tissues rapidly harden to form a smooth shell within which the parasite may pupate. This shell Viereck (1915) designates as the "tunica." The larva now lies with its head at the caudal end of the body of the host and voids its meconium into the opposite end. By the pressure of the body this excrementitious material is formed into a shallow cup-shaped pad fitting closely the outline of the tunica. Shortly after this discharge is completed the larva casts its skin for the last time.

The pupa.—At this time the pupa is pure white in color but very soon pigmentation of the eyes develops and shortly afterwards a general darkening of the entire body takes place. When development is complete the pupal skin is cast and the adult parasite is ready to emerge.

The adult (pl. 18, fig. 1).—Emergence is effected by eating or cutting away a circular hole immediately dorsad of the posterior end of the body. Exceptions to this have been noted but are not frequent. Under summer conditions this takes place within a few hours after the transformation is complete, though it may be delayed till the following day. Feeding upon honey-dew secreted by the mealybugs or upon any other liquid or semi-liquid material at hand begins very soon after emergence. In confinement, feeding has been observed frequently upon the remains of the host from which the parasite has just emerged. This habit is responsible for the appearance at times of empty tunicae bearing two emergence holes of *Zarhopalus corvinus* (Girault), the one in the normal position and the other in the dorsocephalic region, though it is certain that only one parasite had emerged; while feeding on the wax and other materials at the margin of the actual emergence hole the adult parasite had crawled into the tunica and was thus under the necessity of cutting its way out again.

Mating may take place within a short time after emergence and, if the female has been able to feed until satisfied, oviposition is effected within one day. The absence of the male does not appreciably delay oviposition. When reproducing parthenogenetically this species is arrhenotokous, that is, the progeny is exclusively males. Rearings from material collected in the field during September, October, and November gave 56 males to 294 females, revealing a sex ratio for this time of the year of 1 to 5.3.

Oviposition.—The female makes a very rapid examination of the prospective host with the antennae. If the individual is found satisfactory, she turns herself about and inserts the ovipositor into the dorso-caudal region of the body, though also to a certain extent into the cephalic segments. The whole process requires less than one minute. During the period of oviposition the wings are raised above the abdomen. If the host for any reason is not found satisfactory, the period of inspection is greatly prolonged, frequently for half an hour or more. The female parasite seems able to exert a rather limited selective action in the choice of hosts, placing normally only one egg in each, though where the infestation is light, opivosition in the same individual may occur repeatedly. In the laboratory one adult mealybug was confined for six hours with two females of *Zarhopalus corvinus* (Girault) and was found upon dissection to contain fourteen eggs.

While the gravid female is apparently preferred as a host yet oviposition by the parasite is readily carried out in any instar after the first. Frequently, also, the host is able to deposit practically its own full quota of eggs before being destroyed by the parasite. Were this a general condition the actual economic value of the parasite would be greatly reduced.

The life cycle.—At a constant temperature of 30° C. the eggs hatch 48 to 54 hours after being laid, and the first molt occurs 24 to 36 hours later. A slight discoloration of the body of the host is evident about the sixth day after hatching and is accompanied by a marked sluggishness of movement. One or two days later the distended or inflated condition of the body becomes apparent. Death takes place about the ninth day and the parasitic larva then pupates two or three days later. Approximately five days are required for the pupal stadium, thus making a total of about sixteen days from oviposition to emergence. The females normally require about one day longer to complete their transformation. Because of the extremely high temperatures of the

San Joaquin Valley during the summer months this time may be considerably shortened. Under laboratory conditions and with a mean temperature of about 18° C. the life cycle was prolonged to forty days. The winter is passed largely in the pupal instar.

Rate of reproduction.—The period of oviposition under field conditions probably extends over several weeks if host and food conditions are satisfactory. In the laboratory adult females have been kept alive for twelve weeks when not permitted to oviposit. The oviposition records of a series of unfertilized females were secured. The largest number of eggs deposited by one individual was found to be seventy-nine. The period of oviposition extended over twelve days, though the larger proportion was deposited during the first four days. This female then died and upon dissection was found to contain six fully matured eggs and a considerable number in various stages of development in the ovarian tubes. It is probable that under ideal field conditions this rate of reproduction is exceeded. With a complete generation each sixteen to twenty days it will be seen that there is the possibility of a great number of generations each year, as breeding is continuous until November. The presence of large numbers of hyperparasites, however, effects a considerable reduction under field conditions.

INTERRELATIONS OF THE PARASITE AND ITS HOST

Observations based upon rearings of over five hundred *Zarhopalus corvinus* (Girault) from parasitized mealybugs isolated in capsules and, in addition, the dissection of a large series, indicate that neither multiple nor superparasitism occurs in this species. Dissections at various periods of time after oviposition revealed the fact that, while a considerable number of eggs may be deposited in a single host, yet only one ever reaches maturity. A large proportion of the eggs hatch normally, but it is only occasionally that more than one larva reaches the second stage, practically all being dead within one day after hatching and previous to the first molt. Phagocytic action very soon sets in and the dead larvae are encysted in a tough, dark-brown capsule. No instance was observed where, with one larva alive and thriving, the remainder were encapsulated before death. However, in the case of a small proportion of the host larvae, particularly of those from the San Francisco Bay region, a partial immunity seemed to exist with respect to *Zarhopalus corvinus* (Girault), and many larvae were destroyed in the early stages.

This phagocytosis apparently has nothing to do with the death of the larvae, but is merely a reaction set up in the body of the host by the presence of dead foreign matter. It is difficult to explain satisfactorily the causes which give rise to this constant death of all larvae but one immediately after hatching. Even when several of these minute larvae are present in a mealybug's body measuring from three to five millimeters in length, it seems extremely improbable that contact can occur between the different larvae except by accident, as they may be widely separated, and in addition are incapable of moving about freely through the body fluids. The possibility of a combat among the larvae of the first instar for possession of the host therefore seems out of the question. It seems also improbable that the death of the larvae can be the result of any defensive reactions aroused in the body of the host, as a single larva experiences no difficulty. Two theories may be advanced as to the cause of the death of the surplus larvae within a day after hatching. The first of these is that the hatching of the first egg sets up gradually a chemical or other reaction in the body which is sufficient to kill those hatching later, yet the first larva in the meantime attains sufficient strength to overcome the attack. The second theory is that of the direct secretion by the newly hatched larva of some substance inimical to those following, as it may be presumed that the larvae at the moment of emergence from the eggs are weaker and less able to withstand adverse conditions than after they have fed for even a few hours. This latter theory appears to be the more logical.

Acerophagus notativentris (Girault)

Plate 18, figure 2

Acerophagus notativentris (Girault) is a very minute bright-yellow chalcid reared very frequently in large numbers from *Pseudococcus maritimus* (Ehrhorn) on the grape in the San Joaquin Valley. Numerically it exceeds any of the other parasites of this host, though it ranks third in the percentage of mortality effected. In the field on warm days the adults may be observed moving rapidly about in search of food and suitable hosts in which to oviposit, and the distinctive tunicae may be found in considerable numbers on the under sides of the leaves and in crevices in the bark. In California this parasite apparently is limited to the San Joaquin Valley, and it has not previously been recorded from other sections or upon other hosts. Related species are recorded as parasites of dactylopiine Coccidae in various parts of the United States.

LIFE HISTORY

The egg.—The egg as found in the ovarian tubes prior to oviposition is of the two-bodied form characteristic of this group. The egg proper is roundly oval, approximately .07 mm. in length, and connected with the secondary body by a slender stalk of about its own length. This secondary body is slightly smaller and bears a small tubercle on its distal end. When dissected out in a saline solution, the egg is transparent, though the contents are of a granular nature. During the process of oviposition the contents of the smaller body are forced into the egg proper, though the collapsed membrane remains attached. As far as can be determined this has no particular function except during the time when the egg is passing through the ovipositor, as it subsequently lies free in the body of the host.

The larva.—When the embryo is fully developed it breaks the enveloping chorion and passes out into the body of the host, where it very soon begins feeding on the fat bodies and other easily assimilated materials. The digestive tract soon becomes somewhat orange colored, though this is not so evident in the older individuals. The body is of thirteen segments and without special modifications of any sort. The death of the host takes place several days prior to pupation, and in the case of solitary larvae in first instar mealybugs the head of the parasitic larva lies at the caudal end of the body of the host. The meconium, a dark-colored mass of excrementitious material, is voided into the opposite end. When a number of individuals are contained in a single full-grown host this position is not maintained, the determining factor apparently being the position in which the egg was laid and in which the larvae developed. Orientation with respect to the host's body is prevented solely by the numbers present.

The pupa.—The pupa is .5 to .7 mm. in length and in the early stages pure white in color, though within two days the reddish pigmentation of the eyes becomes evident. In the females a slight darkening of localized regions of the abdomen appears shortly before the final transformation.

The adult (pl. 18, fig. 2).—When occurring as a solitary parasite of hosts in the early stage the adult effects its liberation from the tunica by cutting away the three caudal segments. This cap, however, may remain attached at one edge. In the case of hosts containing a number of parasites this emergence hole may either be cut directly through the derm of the host or by way of the cells previously occupied by other pupae. For this reason the number of these external emergence holes is not an exact criterion of the number of parasites which have emerged. Mating has not been observed but under favorable conditions undoubtedly takes place very shortly after emergence, and oviposition may take place the same day. The act of oviposition follows a rather superficial examination of the prospective host with the antennae, the female then turning about and making a series of thrusts with the ovipositor to locate a satisfactory point of insertion, after which the ovipositor is driven into the body, usually ventrally in the mid-lateral region. At this time the tip of the abdomen is forced upward and forward, thus folding the distal portion of the wings back upon themselves in a characteristic manner. Frequently the female will stand practically motionless for one minute or more after insertion has been accomplished if the host does not manifest too great irritation. Occasionally a female will oviposit while standing upon the body of the host, the ovipositor being forced downward and back at a sharp angle.

While *Acerophagus notativentris* is restricted in California so far as known to *Pseudococcus maritimus* (Ehrhorn) as a host, yet females have been observed frequently to oviposit into larvae of various other species of mealybugs. Upon its proper host the females are attached in all their stages. In one case, indeed, a parasite oviposited into a male larva prior to its second molt, yet was able to complete its development, and emerged after the formation of the cocoon. This is not frequent. Another instance was observed where a female oviposited into an egg; this probably was accidental, as several larvae were nearby and had been examined shortly before.

Because of the extreme delicacy and small size of the egg of this species it was not possible to make an accurate record of oviposition by dissection. In rearing experiments a total of 117 progeny were obtained from one fertilized female, the period of oviposition extending over eight days. It is therefore probable that the number of eggs actually deposited was considerably in excess of that which ultimately reached maturity. One mature gravid female was found upon dissection to contain ninety-eight eggs, all apparently fully developed.

Fertilized females produce female progeny largely if not entirely, while unfertilized females give rise to males only. From material collected in the field the sex ratio was found to be 1 to 2.4, the females predominating.

The life cycle.—The egg stage covers a period of about two and one-half days at summer temperature, while the larval period is complete in ten to twelve days, though this may be greatly prolonged during the cooler periods of the year. The host dies shortly before the completion of this stage, though the swollen and slightly discolored condition of the body is evident several days earlier. In the case of solitary larvae in early stage hosts the meconium is voided into the head end of the tunica and is visible through the derm as a darkened area. In a large-bodied host containing a number of parasites the body becomes greatly distorted, due to the fact that the transforming larvae require pupation cells somewhat larger than their own bodies. The outline of each of these cells is evident as a raised area upon the surface of the tunica. The pupal instar covers a period of seven to eight days, thus making a total of twenty to twenty-three days from egg to adult under summer conditions.

Superparasitism.—The number of eggs deposited in a single host is problematical, though in larvae in the first stage it is seldom more than one. In the later stages the number is frequently in excess of the available food supply, and therefore the surplus larvae must die sooner or later. If an insufficient number has been deposited in a single host to entirely consume the body tissue the result is frequently the death of both host and parasites. This is due to the fact that when the larvae reach maturity the host may still be alive and, as the larvae cannot pupate in a liquid medium, they ultimately perish. If the discrepancy is not too great the parasites may eventually be able to emerge, their development being arrested during the time required for the body of the host to dry out and solidify. Finally, if only a few are present in the body they probably die and become encysted, and cause no particular injury to the host.

The largest number of *Acerophagus notativentris* (Girault) thus far reared from a single adult female of *Pseudococcus maritimus* (Ehrhorn) was twenty-seven, as contrasted with the single parasite which can develop in one female in the first instar.

Anagyrus subalbicornis (Girault)

Plate 19, figure 3

Anagyrus subalbicornis (Girault) ranks third in point of numbers among the parasites of the grape mealybug in the San Joaquin Valley, constituting 21.6 per cent of all individuals reared from field material.

In effectiveness, however, it exceeds *Acerhophagus notativentris* (Girault), which ranks first numerically, because of the fact that it is a solitary parasite while the latter averages nearly eight to the individual host, thus greatly reducing the total number destroyed.

So far as known at the present time this species is restricted in its habitat entirely to *Pseudococcus maritimus* (Ehrhorn) upon the grape in the San Joaquin Valley. Several species of this genus have been found in Southern California upon various mealybugs, though none upon the one above mentioned.

Great difficulty was experienced in rearing this species in the laboratory and it has therefore not been possible to make detailed study of the life history. The following notes are based upon a large number of dissections of field material and upon various laboratory observations.

LIFE HISTORY

The egg.—The ovarian egg differs in no essential respect from that of *Zarhopalus corvinus* (Girault). The egg proper is broadly oval and connected by a slender stalk to the elongate lemon-shaped supplementary egg. The total length is approximaetly .5 mm., and the various parts in the order above given are .22 mm., .11 mm., and .17 mm. in length, respectively. The point of union of the stalk with the main egg is somewhat below rather than at the exact center of the posterior end. At the time of oviposition the entire contents are forced into the main body, though the stalk remains and serves as a means of attachment for the egg to the derm of the host. At this time the egg is approximately .27 mm. in length, and its length increases somewhat with the development of the embryo.

The larva.—At the time of hatching the shell is broken at the head end and the young larva works its way partially out through this opening, its caudal end, however, remaining attached to the stalk. This connection is apparently maintained throughout all of the larval stages except the last, each molted skin in turn being forced back over the body and remaining as an envelope surrounding the caudal segments. The mature larva attains a length of approximately 2.00 mm.

The pupa.—The pupa passes through the usual changes in color, with later a black pigmentation appearing in the eyes. During this period the sexes may be readily distinguished, the antennae of the male darkening uniformly throughout while those of the female remain white in the outer half and possess the exceptionally broad and long scape.

The adult (pl. 19, fig. 3).—The adult female is characterized by antennae having a long, broad scape which, together with the two succeeding segments, is dark in color as contrasted with the pure white of those following. The antennae of the male lack the conspicuous scape, are uniformly dark colored in all segments, and bear numerous heavy bristles. Because of the great scarcity of males it is improbable that fertilization is general, and reproduction must therefore be largely parthenogenetic.

Oviposition.—Oviposition takes place in the usual manner, in the mid-lateral region. The host instar most favored is the second, the larvae at this time being about 1.00 mm. in length or considerably less than half-grown. If these are lacking, however, the female will oviposit into the first instar or mature larvae. In the case of very young larvae the parasite is often unable to withdraw the ovipositor, and the impaled larva is therefore carried about for a considerable period of time; or, again, until it can be wedged into some crevice and the ovipositor withdrawn. This habit of ovipositing in larvae in the early stage but delaying development until the host is nearly full-grown, has been observed in several other species of *Anagyrus* parasitic upon dactylopiine Coccidae.

Life cycle.—While oviposition takes place largely in the young larvae yet the death of the host is not brought about until it has attained practically mature size, thus indicating that the period of development is somewhat longer than that of the other species under consideration. Previous to the death of the host there is no noticeable discoloration of any portion of the body. While the derm of the tunica is considerably darkened, this is not evident externally because of the unusually heavy wax secretion. The interior surface is very smooth and highly polished as compared with that of *Zarhopalus corvinus* (Girault).

Emergence is effected by cutting away a circular opening at some point in the wall of the tunica, usually in the posterior area of the ventral surface, though frequently dorsally or at the head end.

The winter is passed almost exclusively in the mature larval and pupal instars and emergence takes place comparatively late in the spring. Material collected in the field during November and kept under temperature conditions of approximately 20° C. required over two months for emergence as contrasted to the four weeks required by *Zarhopalus corvinus* (Girault).

Pseudleptomastix squammulata (Girault)

Thus far this species has been recorded only from the San Joaquin Valley in California, where it is restricted to *Pseudococcus maritimus* (Ehrhorn) as a host. It may at times be found frequently in the field, particularly during the hotter periods of the summer. In numbers and in effectiveness it ranks fourth among the parasites of this host, being exceeded by the three previously discussed. Its attacks are confined strictly to those stages in which the host measures less than about 1.5 mm. in length, therefore largely to the second instar. Repeated efforts to reproduce it upon other species of the genus *Pseudococcus* have all resulted negatively.

LIFE HISTORY

The egg.—The ovarian egg is of the usual two-bodied form, with the main body 0.9 mm. in length, roundly oval, and connecting by a slender stalk of about its own length with the secondary egg, which is somewhat smaller and bears an indistinct protuberance at its apical end. The total length is approximately .25 mm. When dissected out in a saline solution the contents of the egg proper are distinctly granular in appearance.

During the course of oviposition the contents of the smaller body are forced into the larger, which thereby attains a length of .17 mm., while the stalk, which is now half to two-thirds this length, serves as an attachment to the derm of the host, its distal end extending outside the body but obscured by the waxy secretion. The egg enlarges somewhat with the development of the embryo, and, upon hatching, the chorion is broken and forced back over the body, though the young larva remains attached at its anal end to the stalk.

The larva.—During at least the first two stages of development the larva retains a close attachment to this stalk, the function of which has been described as respiratory. At the time of molting the cast skin is forced back over the body, and forms a distinct cone around the caudal segments. The dark colored contents of the digestive tract are clearly visible through the derm.

The pupa.—The pupa is pure white in color during the few days immediately following the casting of the final larval skin, but the dark coloration of the eyes, thorax, and abdomen soon appears on these parts in turn. During the latter part of this instar the sexes may be readily distinguished by the difference in antennal form and coloration, those of the female having a much larger scape and pedicel and with the apical portion of each, and the club also, very light in color.

The final transformation is effected within the tunica and emergence is effected by cutting a small hole near one end.

The adult.—The adult female may be readily distinguished from the male by the greater length of the scape and the pedicel of the antennae, and by the differences in coloration as noted above for the advanced pupa. In the male the color of the antenna is uniform throughout and each segment bears a large number of coarse bristles.

Feeding takes place normally very shortly after emergence, and also mating, though the relative scarcity of males indicates that parthenogenetic reproduction may occur frequently in the field. The numbers available in this study have not been sufficiently large to permit accurate determination of the sex ratio. Of the forty reared from the material collected three were males.

Oviposition.—Under normal conditions oviposition is restricted almost entirely to the first and second instars of the host. The female parasite examines the host larva carefully with the antennae, these being held perpendicularly so that the tips only come in contact with the body of the host. When satisfied as to its desirability she turns about and thrusts the ovipositor backwards into the mid-dorsal region. If the host's body is large enough she may stand upon it during the process, holding the wings at an angle of about 45 degrees above the plane of the body. The entire time required for examination and oviposition is usually less than one minute. In the case of very small larvae their death may be brought about solely from injury incident to the insertion of the ovipositor, irrespective of whether an egg is deposited or not. This was demonstrated in a number of cases with *Pseudococcus gahani* Green and *P. citri* (Risso), which always destroy the egg by phagocytic action before it hatches; yet many of the larvae died from mechanical injury.

The life cycle.—Under summer conditions the cycle from egg to adult is complete in twenty-four to thirty days. The death of the host occurs ten to fourteen days after oviposition, being preceded a few days by a distinct discoloration of portions of the body, and by the darkening of the hypodermal tissue. The tunica is perfectly cylindrical in form, with both ends smoothly rounded; in texture it is very tough and strong, thus affording more protection from hyperparasites than is the case with other species. The wax covering of the tunica is very light at this time, in fact it may be entirely lacking, so that the darkened derm and the parasite pupa contained within are clearly revealed. This lack of the waxy covering, together with the semitransparent condition of the tunica, serves as a ready means of identification of individuals parasitized by this species.

The winter months are passed in the pupal stage only, and this dormant period is much more pronounced than in any of the other species under consideration. A series of mature larvae and pupae were collected in the field during October and kept at room temperature (about 20° C.) for three months, after which some were placed in an incubator with a constant temperature of 31° C. Under these conditions a small proportion emerged after ten days, while those kept at room temperature emerged some six weeks later. It is apparent that emergence in the field does not occur until late in the spring as compared with other species. At this time the host larvae are in the proper stage for parasitism, and are upon accessible portions of the vine.

Chrysoplatycerus splendens (Howard)

Chrysoplatycerus splendens (Howard) was first described from California in 1888. At the present time it is of more or less general distribution, though as far as known it is restricted to this state. Its favorite host is the common mealybug, *Pseudococcus citri* (Risso). Upon this species it has been recorded from practically all infested sections of Southern California and at Marysville in the Sacramento Valley. Essig (1911) reports it as very numerous in Ventura County during 1910 and 1911, and also reports it (1914) upon *Pseudococcus gahani* Green at Uplands, California. It has been reared by the writer in large numbers from *Pseudococcus maritimus* (Ehrhorn) at Riverside and occasionally at Pasadena. In recent years a considerable reduction in numbers seems to have taken place and it is now only occasionally met with.

Living material has not been available during the past season for use in studies of the life history, but previous records give the life cycle as approximately twenty-five days under summer conditions. Middle stage larvae or mature females are parasitized, and only one individual ever emerges from a single host. This species is arrhenotokous, the progeny in parthenogenetic reproduction being exclusively males.

Pseudaphycus angelicus (Howard)

This minute encyrtid is not frequently met with as a parasite of *Pseudococcus maritimus* (Ehrhorn), though several were reared from material collected at Riverside during October, 1914, and one female from *Pseudococcus gahani* Green at Uplands in September, 1914. What is apparently the same species was also reared in considerable numbers from *Pseudococcus longispinus* (Targioni Tozzetti) collected at Santa Barbara. Timberlake (1912) records it as reared by various collectors from *Pseudococcus ryani* (Coquillett), *Pseudococcus longispinus* (Targioni Tozzetti), and from undetermined species at Los Angeles, Pasadena, and Whittier. Its distribution is therefore general over Southern California.

HYPERPARASITES

Thysanus elongatus (Girault)

Plate 19, figure 4

This signiphorid is by far the most important of all the hyperparasites of *Pseudococcus maritimus* (Ehrhorn) in California, and acts as a decided check upon the increase of *Zarhopalus corvinus* (Girault), *Anagyrus subalbicornis* (Girault), and *Pseudleptomastix squammulata* Girault.

In 1913 the family was monographed by Girault (1913) and of the twenty-seven species with known host records, all are given as primary parasites of Coccidae and Aleurodidae with one exception, which was recorded from a psyllid. It is therefore rather remarkable that the species under consideration should prove to be a hyperparasite. In Japan the writer has observed two species upon dactylopiine Coccidae, and both were secondary. It is quite probable that a considerable number of those previously listed will also prove, upon further investigation, to be secondaries.

In the rearing records of material collected in the field at Fresno, California, given elsewhere in this paper, it will be seen that, of a total of 1800 parasites reared from 984 individuals of *Pseudococcus maritimus* (Ehrhorn), 436, from 156 hosts, were *Thysanus elongatus* (Girault). As previously stated, this proportion would probably have been greater had the material remained continuously under field conditions till emergence. Disregarding the parasitism of *Pseudleptomastix squammulata* (Girault) and *Acerophagus notativentris* (Girault), which is of little consequence numerically as compared with the total, and assuming no preference between *Zarhopalus corvinus* (Girault) and *Anagyrus subalbicornis* (Girault), we find that *Thysanus elongatus* (Girault) has effected a reduction of at least 25 per cent in the numbers of those two species during the last generation. In the number of individuals in this overwintering generation, however, there were 436 *Thysanus elongatus* (Girault) as compared with 280 of *Anagyrus subalbicornis* (Girault). It is therefore very probable that the following season would see a considerable reduction in the numbers of these two species as compared with 1919, when they were exceptionally numerous.

Thysanus elongatus (Girault) is a general feeder and has been found as an ectoparasite upon the advanced larval and pupal stages of *Zarhopalus corvinus* (Girault), *Acerophagus notativentris* (Girault), *Anagyrus subalbicornis* (Girault), and *Pseudleptomastix squammulata* Girault. In one case it was found feeding upon an adult *Pseudleptomastix squammulata* Girault which had not yet emerged, and similarly on one occasion upon *Zarhopalus corvinus* (Girault). In these two cases it is probable that the egg was deposited while the host was in the advanced pupal instar, and did not hatch sufficiently early to bring about the death of the host before its final transformation. The host may even have been in the adult stage at the time the egg was laid, yet remained dormant in the tunica, while the parasite developed normally and brought about its death.

One case of secondary combined ecto- and endoparasitism was observed, that of two *Thysanus elongatus* (Girault) larvae, and one of *Achrysopophagus modestus* Timberlake feeding externally and internally, respectively, upon a pupa of *Zarhopalus corvinus* (Girault). As the ultimate result of this struggle one *Thysanus elongatus* (Girault) reached the adult stage, while the *Achrysopophagus modestus* Timberlake larva was killed and the other *Thysanus elongatus* (Girault) died apparently from lack of food. This result is what would naturally be expected when external feeders are pitted against endoparasites for the possession of the host.

As an accidental tertiary parasite, a *Thysanus elongatus* (Girault) larva was observed feeding upon a pupa of *Tetrastichus blepyri* Ashmead, which previously had developed upon a similar stage *Anagyrus subalbicornis* (Girault). This also occurred upon a pupa of *Achrysopophagus modestus* Timberlake from the same host.

LIFE HISTORY

The egg.—As compared with the size of the adult female, the length of which is .7 to .9 mm., the egg of this species is of remarkable size, being .22 mm. in length and .07 in diameter. The ventral surface is only slightly curved, while dorsally it is distinctly convex. The posterior pole is smoothly rounded, while that opposite is prolonged into a very large and distinct tubercle, which is quite translucent as compared with the pearly white color of the egg proper.

The larva.—Immediately after hatching the young larva fixes itself to the body of the host and commences feeding. The color at this time is uniformly white, though very soon the digestive tract becomes brownish. The segmentation is very distinct during the first and second stages but less so in the third.

After the body contents of the host have been consumed there is a quiescent period of several days, after which the meconium is discharged more or less at random within the tunica. Pupation takes place one to three days later.

The pupa.—A portion of the meconial discharge serves as a means of attaching the tip of the abdomen of the pupa to the wall of the tunica or to the dead body of the host. At first the pupa is pure white in color but very soon the reddish pigmentation of the eyes becomes evident. The coloration of the remaining portions of the body then appears in a very unusual order. First, the dorsal surface of the abdomen darkens, then the ventral surface, and the entire abdomen is completely black before the beginning of pigmentation of the head, thorax, or wing pads.

The adult (pl. 19, fig. 4).—After the final transformation the adult may remain for some time within the tunica. Emergence is effected by cutting away a small circular aperture in the wall of the tunica, and through this one hole all the adults emerge in turn. They are uniformly blue-black in color with the exception of the tarsi, which are yellow, and the females may be readily distinguished by the exceptionally large abdomen and the modified form of the antennae.

Oviposition.—The female *Thysanus elongatus* (Girault) will oviposit only upon the pupa of its host or upon the larvae which have brought about the death and the hardening of the integument of the mealybug host. The act of oviposition is considerably prolonged because of the difficulty experienced in piercing the tunica and also because of the fact that a number of eggs are deposited at one time without removing the ovipositor. After a thorough examination of the host with the antennae, the female either turns around and begins the work of piercing the tunica or she may stand upon it and force the ovipositor downward by the pressure of the body. In one case observed the female remained with the ovipositor inserted in the host for eighty-two minutes, during which time she deposited five eggs. After the shell has been pierced the surface of the host larva or pupa is examined with the tip of the ovipositor and at the same time a small quantity of adhesive material is applied, by means of which the egg may be firmly attached to the body. After the egg has been forced through the ovipositor a series of thrusts are made to press it flat against the body: it is not permitted to remain attached merely at the tip, in which position there would be danger of its being injured. The female rests for a few moments and then repeats the process. From three to six eggs may be deposited upon one host; this is usually the maximum number that can be brought to maturity. Dissections of gravid females have shown also that this is the usual number of mature eggs to be found in the ovarian tubes at any one time. Because of this fact and of the great relative size of the egg, the total number deposited is not great, though oviposition may extend over several weeks. The greatest number of eggs deposited by a single female in the laboratory was twenty-seven, covering a period of thirteen days.

At summer temperatures the egg, larval, and pupal stages require three to four, fifteen to eighteen, and seven to eight days, respectively. These stages may be greatly prolonged at lower temperatures. The winter is passed in the advanced larval or pupal stage. At a mean temperature of about 18° C. females have been kept alive for thirteen weeks when fed upon sugar solution and not permitted to oviposit. When oviposition takes place normally the period of life is but a few weeks.

Parthenogenetic reproduction results in males exclusively. Field collections gave a total of 74 males to 364 females, or a sex ratio of 1 to 4.9.

Achrysopophagus modestus Timberlake

This species is one of a number in this group which have been found in California as indirect parasites of Coccidae. Timberlake (1913) records one species of this group as parasitic upon *Microterys flavus* (Howard), a primary parasite of *Coccus hesperidum* Linnaeus, and states that other species are probably similar in habit though at present on record as primary parasites. The species here under consideration has been reared frequently from host material collected in the San Joaquin Valley. It is an endoparasite of the mature larval and pupal stages of *Zarhopalus corvinus* (Girault) and *Anagyrus subalbicornis* (Girault). All individuals thus far reared have been females, indicating that the species is normally parthenogenetic, at least during a portion of the year.

The life history and habits of this species correspond very closely to those of *Eusemion longipenne* (Ashmead) as given by Timberlake. The females are apparently not able to determine by any sensory reactions the suitability of the host for oviposition while the primary parasite is in the earlier stages, but are able to detect the presence of a mature larva or pupa within the tunica after this stage is reached. The main reliance is placed upon the ovipositor, which is used as a probe to locate the primary larva in the body of the host. In cages in the laboratory individuals have been observed in a rapid examination of mealybugs in all stages, and in each of these the ovipositor was inserted at the rate of several times per minute for three hours without interruption. Even the newly hatched larvae were pierced in this way, and because of their small size were very frequently carried about on the ovipositor for some time before they could be detached. In the case of primary parasites which were in a sufficiently advanced stage to have killed the host, considerable time was required by the *Achrysopophagus modestus* Timberlake female to pierce the hard shell of the tunica. After this was accomplished the ovipositor was thrust into the body of the primary and the egg deposited therein. No case was observed in which an egg was laid in a mealybug that did not contain the larva of a primary parasite.

The ovarian egg consists of a lemon-shaped body approximately .14 mm. in length, to which is attached a slender stalk .15 to .20 mm. long. This stalk is only slightly dilated at the apical end and is therefore not comparable in size with the supplementary bodies of the eggs of the other species studied. At the time of oviposition the contents of this tube are forced into the main body, though the collapsed tube still remains attached, a structure apparently without function. The egg is free-floating in the body of the host and, as the embroyo develops, increases greatly in size because of the absorption of nutrient materials from the blood of the host. The maximum length attained just prior to hatching is about .35 mm., while the newly emerged larva when fully extended is .60 mm. in length. The segmentation is distinct, and the caudal segment is prolonged into a pronounced tail-like appendage which persists through the early larval stages. The relative size of this appendage is considerably reduced in the second stage.

The mature larva is also distinctly segmented, unusually broad at the cephalic end, and tapering caudad, thus taking a club-like form.

The pupa is pure white in color until a few days prior to the final transformation, when it begins to darken uniformly. This species is readily distinguished in the pupal stage because of the sharp prong arising from the apex of the scutellum, which is represented in the adult female by a tuft of long heavy hairs.

The complete life cycle requires from twenty-three to twenty-six days at summer temperature, and the dormant season is passed in the pupal stage. The death of the host larva or pupa occurs within two or three days after the hatching of the egg, so that development at this time must be very rapid. In case oviposition has taken place a number of times in the same host, the death of the host may be brought about solely by mechanical injury, and under these circumstances the *Achrysopophagus modestus* Timberlake larva also dies.

If two or more eggs are deposited within a single host, all hatch normally and feed freely and without interference with one another upon the body fluids. Eventually the body contents are largely consumed, and this prior to the attainment of maturity by the parasitic larvae. Consequently, a struggle takes place among them and the one surviving consumes the others and thus completes its development. In not a single instance have two *Achrysopophagus modestus* Timberlake been observed to mature on a single host, and the size of the adult parasite practically precludes the possibility of this taking place.

Tetrastichus blepyri Ashmead

This tetrastichine is a comparatively rare secondary parasite of *Pseudococcus maritimus* (Ehrhorn), one female having been reared from material from Riverside, California, in 1914 and three females from the entire quantity of material collected in the San Joaquin Valley during the 1919 season. This species is ectoparasitic upon the mature larvae and pupae of *Zarhopalus corvinus* (Girault), *Anagyrus subalbicornis* (Girault), *Pseudleptomastix squammulata* Girault, and *Chrysoplatycerus splendens* (Howard).

The adult female is very deliberate in her choice of hosts for oviposition and examines them thoroughly though slowly to determine their suitability. Only those which have a mature larva or pupa contained within a well hardened tunica are chosen. After crawling about over the host and tapping it with the antennae until satisfied, the female lowers the tip of the abdomen and places the ovipositor perpendicularly in position, after which the abdomen is raised and the downward pressure of the body brought into play, which ultimately forces the ovipositor through the hard shell of the tunica. This frequently requires ten to fifteen minutes, and after being accomplished the ovipositor is several times thrust its full length into the tunica to determine a satisfactory point at which the egg may be attached, after which it is laid flat upon the body of the host.

The egg is pure white in color, .35 mm. in length, both poles smoothly rounded, with no evidence of any micropylar structure. The ventral side is slightly concave, while dorsally it is more convex. Upon hatching the young larva immediately fastens itself to the host body and begins feeding upon the body liquids. The death of the host ensues after four to seven days. Pupation takes place about ten days after hatching and the adult emerges five or six days later, thus requiring a total of seventeen to nineteen days from egg to adult at a constant temperature of 31° C. Both the mature larvae and the pupae of this species may be readily recognized, as they are distinctly cream-colored as compared with the white of other species.

Occasionally two individuals will reach maturity upon a single host, though this is quite exceptional and restricted largely to the males because of their smaller size. The usual consequence in case of two eggs being deposited upon the same host is that both die before emergence.

This species is arrhenotokous when reproducing without fertilization, the progeny being males exclusively.

Subprionomitus sp.

Among the hyperparasites reared from the material collected at Fresno during 1919 were twenty-four males of this encyrtid. Strangely enough, not a single female was reared; consequently a more exact determination, as well as a study of life history and habits, have not been possible. Several pupae were secured from dissections and could be very easily recognized by the characteristic position of the antennae, these being curved backward and away from the head, the median portions being entirely free from contact with the body itself.

The dissections above referred to revealed that the species was parasitic upon *Anagyrus subalbicornis* (Girault) and *Zarhopalus corvinus* (Girault). It was also reared from the first named and from *Acerophagus notativentris* (Girault). These reared specimens emerged considerably later in point of time than did *Achrysopophagus modestus* Timberlake which was developing in the same material, and only shortly before *Pseudleptomastix squammulata* Girault.

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EXPLANATION OF PLATES

PLATE 18

Fig. 1. ***Zarhopalus corvinus*** **(Girault). Adult female.**
Fig. 2. ***Acerophagus notativentris*** **(Girault). Adult female.**

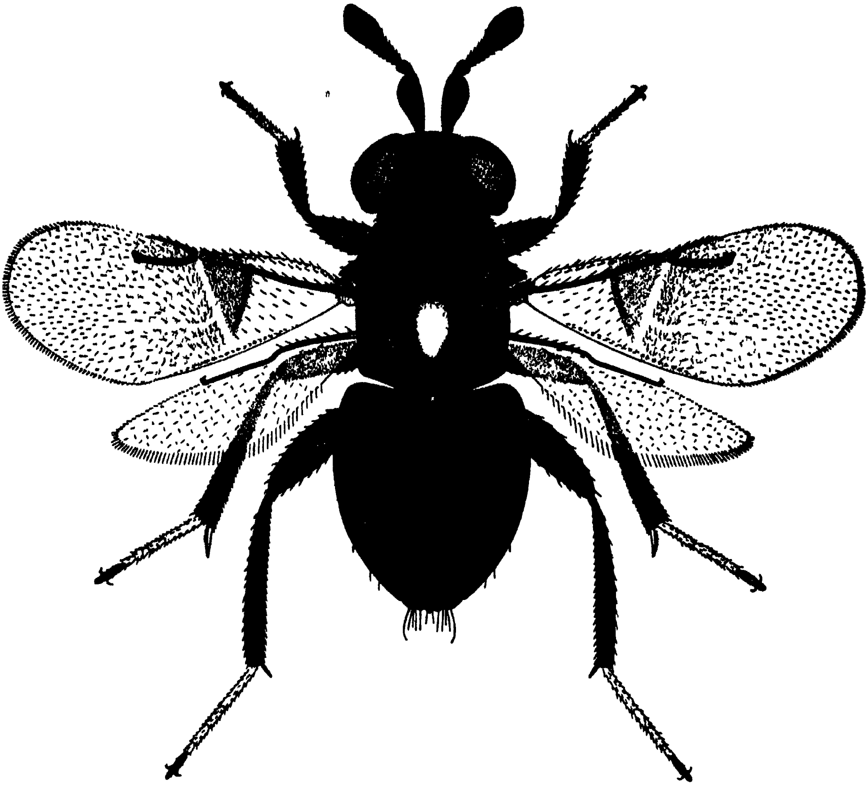

Fig. 1

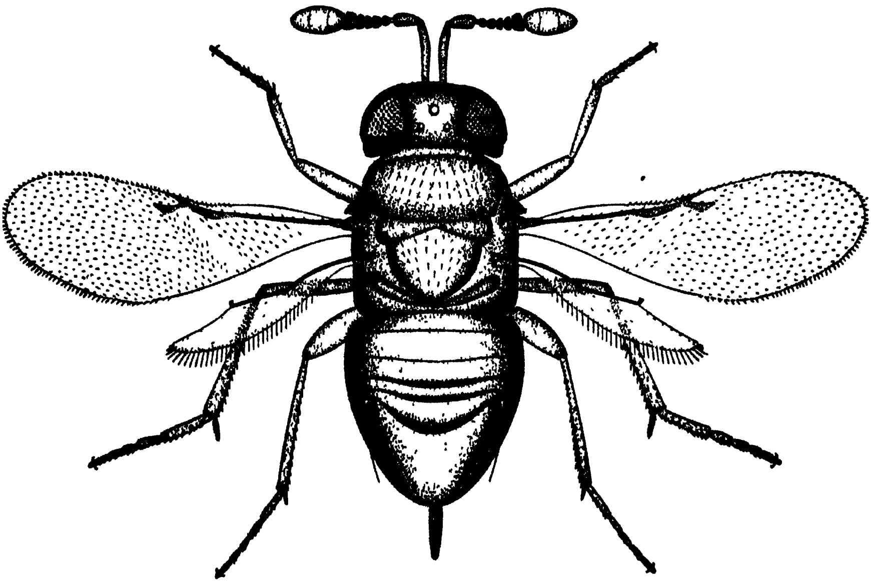

Fig. 2

PLATE 19

Fig. 3. ***Anagyrus subalbicornis*** **(Girault). Adult female.**
Fig. 4. ***Thysanus elongatus*** **(Girault). Adult female.**

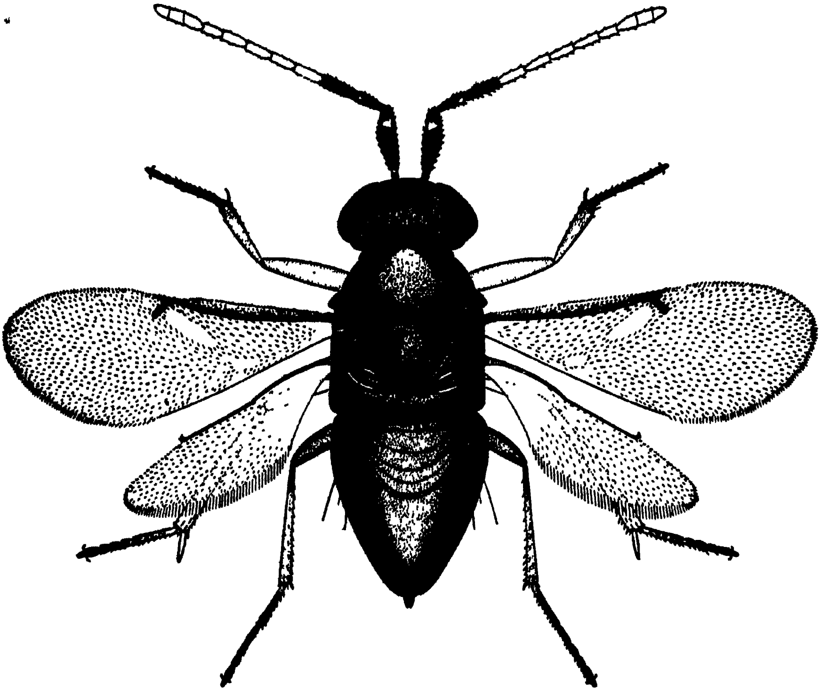

Fig. 3

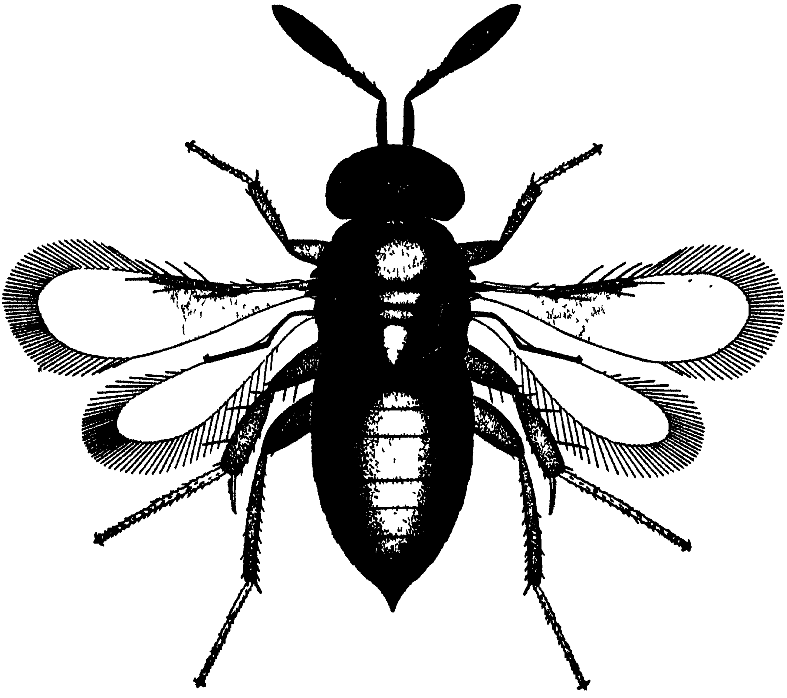

Fig. 4

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ENTOMOLOGY
Vol. 3, No. 3, pp. 295-326, plates 20-26 January 14, 1925

NEW CHALCIDOID (HYMENOPTEROUS) PARASITES AND HYPERPARASITES OF THE BLACK SCALE, SAISSETIA OLEAE BERNARD*

BY

HAROLD COMPERE

In southern California several hyperparasites are coming into prominence in a newly acquired rôle as destroyers of the primary parasite *Aphycus lounsburyi* How. *Aphycus* is of considerable importance as an enemy of the black scale *Saissetia oleae* (Bern.). It was introduced into California in the fall of 1919 by the State Department of Agriculture to aid in checking the depredations of *S. oleae* (Bern.). The parasite is now commonly found throughout the areas where its host occurs, and is credited with having produced some very good results. With the increase and spread of *Aphycus lounsburyi* How., there has been a corresponding increase of hyperparasites which have been multiplying at its expense. Prior to the introduction of *Aphycus*, these hyperparasites were of little economic importance, in fact were almost unknown, but their status is quite different today. For they are greatly restricting the multiplication of a parasite which was doing much toward reducing the infestations of a most pernicious citrus pest. In some localities certain of the hyperparasites have increased to such an extent that they actually outnumber the primary parasites. Ten or more species of hyperparasites are now suspected of preying on *Aphycus lounsburyi* How. in southern California, while the host relations of three others—one species of *Cheiloneurus*, *Perissopterus mexicanus* How., and a Eupelmine which have been taken in association with the black scale have not been determined experimentally.

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* Paper No. 113, University of California, Graduate School of Tropical Agriculture and Citrus Experiment Station, Riverside, California.

The following species, listed in the order of their importance, have been reared experimentally on the larvae or pupae of *Aphycus lounsburyi* How.: *Quaylea whittieri* (Gir.), *Eusemion californicum* n. sp., *Tetrastichus blepyri* Ashm., *Cheiloneurus inimicus* n. sp., *Cheiloneurus lineascapus* Gahan, *Eupelmus inyoensis* Gir., and *Thysanus niger* (Ashm.). The second species described in this paper as new, *Cheiloneurus noxius* n. sp., has not actually been reared on *A. lounsburyi* How. The female which was held for experimental work repeatedly made insertions with her ovipositor in black scale containing pupae of *Aphycus* but no progeny were reared as a result of this experiment.[1]

Cheiloneurus inimicus n. sp. is outranked in destructiveness by at least four hyperparasites of *Saissetia oleae* (Bern.). *Quaylea whittieri* (Gir.) outranks all the other hyperparasites combined, being the most abundant and widely distributed, and capable of preying upon the primary inhabitants of several different coccids. *Eusemion californicum* n. sp. and *Tetrastichus blephyri* Ashm. have seriously hampered the activities of *Aphycus* in some localities and are of much importance. The remaining species, with the possible exception of *Perissopterus mexicanus* How., have not, as yet, made any great progress and may be considered of minor importance. This may not always be true, however. Within the short period of three years, *Quaylea*,

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[1] The writer wishes to acknowledge his indebtedness to Dr. L. O. Howard and to Messrs. A. B. Gahan and S. A. Rohwer for critical reading of this paper. To Professor Harry S. Smith I am indebted for helpful advice. Mr. P. H. Timberlake has generously given me much time and assistance, which is more fully acknowledged in the text. Mr. Gahan has also favored me by determining a number of specimens. He is also responsible for the naming of the species of *Eupelmus* sp. termed *inyoensis* Gir. In a letter under date of July 12, 1922, he wrote in regard to this form: "I am unable to distinguish these Eupelmines from *Eupelmus inyoensis* Girault, a species which he described from specimens reared by Koebele from a dipterous gall on *Artemisia* at Inyo, California. The specimens of this genus are extremely difficult to separate, and it may be that I am mistaken in the identification, although your specimens agree with the types in all the characters known to me. The species of *Eupelmus* are apparently quite diversified in habits; but I know of no species which attacks both dipterous gall makers and scale insects."

Mr. Timberlake, in a letter dated July 28, 1921, wrote:

"I have reared this species [*Eupelmus inyoensis* Gir.] from a *Bruchus* in the seeds of *Amorpha* from the Puente Hills near Whittier, and from *Asphondylia adenostoma* Felt, a Cecidomyiid working in the seeds of *Adenostoma* taken in Laurel Canyon near Hollywood."

Gahan is responsible for the determination of *Thysanus niger* (Ashm.). Timberlake and Gahan concur in stating that the *Tetrastichus* is undoubtedly Ashmead's species *blepyri*. Specimens of the *Perissopterus* were determined as *mexicanus* How., by Gahan, after comparison with the type.

Timberlake has stated that the *Eusemion* and *Cheiloneurus* herein described are new species. I am also indebted to him for reading and correcting portions of my manuscript.

Eusemion, and *Tetrastichus* have increased from insignificant to startling numbers, and there seems to be no reason to believe that the other forms are not capable of making an increase if provided with adequate quantities of suitable food. All the hyperparasites are a menace and a source of potential danger, for undoubtedly the local fauna will be enriched by importations of additional primary species which may prove to be just as attractive as *Aphycus lounsburyi* How.

A few specimens of *Cheiloneurus inimicus* n. sp. were obtained first from black-scale material collected at Duarte, California, in the summer of 1922. More recently many specimens have been collected from windows of the Sierra Madre-Lamanda Park Insectary, where a great quantity of material infested with black-scale was accumulated for use in rearing *Aphycus* for distribution. A single female was obtained from *Physokermes insignicola* (Craw.) sent from Santa Maria, California, on twigs of the Monterey pine, *Pinus insignis* Dougl. The *Physokermes* were heavily parasitized by the primary parasite *Aphycus physokermis* Timb., which probably served as the host of the *Cheiloneurus*.

Cheiloneurus inimicus n. sp.

Plate 20, figures 1–3

Although the species herein described conforms more nearly to *C. dactylopii* How., in Gahan's key to the North American forms, yet it differs greatly and may be readily separated by numerous prominent characters. In the antennal characters this species ranges with *C. cyanonatus* Wtrst. and *C. praenitens* Wtrst. It is an extremely variable species, especially in coloration. In typical specimens, the first three or four funicle joints are blackish, the fifth testaceous, the sixth blackish, while in the case of the extreme variants all the joints may be almost wholly either blackish or yellowish. The coloration of the abdomen ranges from light yellow tinged in parts with dusky metallic to wholly blackish above. The variation of the antennal joints and of the comparative widths of the frontovertex is slight. The extreme forms although quite dissimilar in coloration and to a lesser extent in structure and vestiture are specifically related, as is shown by numerous intergrading specimens.

THE FEMALE

Characters.—Head, dorsal aspect, about one and one-half times wider than long; frontovertex a trifle more than two and one-half times longer than wide, and ranging a trifle under one-fifth as wide as the head; ocelli arranged in an acute-angled triangle, posterior pair almost touching eye margins and a little more than their own diameter from occipital margin; head, frontal view, as wide as high; eyes extend downward three-sevenths the depth of head; antennal sockets about three times their greatest diameter apart and about one-half their own diameter above oral margin; antennal scape expanded below, two and three-fourths times longer than wide, a trifle longer than the club; pedicel about two and one-third times longer than wide, as long as the first two and one-half of third funicle joints combined; funicle joints gradually widen distally so that the sixth is almost twice as wide as the first; first four funicle joints are subequal in length, the sixth about one and one-half times as long as the fifth; club oblong, as wide as the scape, not quite so long as funicle joints taken together. Dentition of mandibles shown in plate 20, figure 1*c*. Scutum almost twice as wide as long; axillae moderately well separated; scutellum slightly wider than long; abdomen as long as thorax; ovipositor sheaths exserted one-eighth the length of abdomen. Wing venation, vestiture, and embrowned pattern shown in plate 20, figures 1 A and D.

Sculpture.—Face, cheeks and frontal ledge microscopically reticulate; semicircular scrobes appear smooth and polished; frontovertex, minutely punctulately shagreened; a row of setigerous pin punctures paralleling the inner orbits, in addition a few scattered on vertex and several on anterior frons; pronotum and mesoscutum finely reticulate with numerous setigerous punctures; punctures of silvered area larger and elongate, being modified for insertion of the sword shaped transparent hairs; axillae and scutellum opaque, more coarsely and deeply punctulately shagreened than the head, under low power appearing somewhat granular; metanotum with transverse lineolations; propodeum smooth; abdomen above with delicate reticulations.

Vestiture.—Eyes with very few microscopic fine whitish hairs; setigerous punctures on frontovertex set with small blackish hairs, those under eyes with more conspicuous long white hairs; cheeks and prominence between antennal sockets with small blackish hairs, in addition a fringe of longer hairs above oral margin; pronotum with a single row of rather strong black hairs parelleling hind margin, usually about twenty-two in number; mesoscutum anteriorly usually with numerous scattered black hairs, in some specimens rather sparse; mesoscutum posteriorly with flat, sword-shaped, transparent scale-like hairs, in addition hind margin set with six to eight strong black hairs, the median pair opposite base of axillae; axillae and tegulae with strong black hairs, the number on each varying from three to six; scutellum usually with about twenty smaller hairs clustered about base of the prominent apical tuft.

Coloration.—Frontovertex refringent olive green over brownish yellow, darker in proximity to the vertex; face ferrugino-testaceous and with a blackish band arching oral margin; cheeks under the eyes and merging into anterior frons suffused with dusky metallic; the eyes in life testaceous; occiput in proximity to mouth parts slightly tinted with dusky; base of stipes and mentum tinged with blackish; radicle joint of antennae blackish; usually ventral portion and dorsal margin of scape blackish, in many specimens dorsal margin concolorous with the yellowish sides; pedicel with dorsal half or occasiounally only the margin blackish, the under portion yellowish; in majority of specimens first three or four funicle joints blackish, the fifth yellowish, and sixth blackish; in the series of specimens examined almost every possible gradation from entirely black to yellowish occurs; antennal club blackish; center of pronotum blackish, the remainder yellowish; anteriorly, mesoscutum is yellowish or testaceous, the posterior third or so crossed by a broad purplish black band overlain by an iridescent silvery sheen caused by the play of light through the clothing of transparent scale-like hairs; axillae and scutellum, opaque, yellowish or ferrugino-testaceous, the sides of scutellum occasionally marked with dusky; metanotum yellowish, sometimes with a dark tinge; propodeum usually dark, the sides with metallic luster, episternum ranges from chrome yellow or testaceous to dark metallic behind; abdomen above, yellowish or dark refringent metallic, or more often particolored, in majority of specimens the basal abdominal segments and apex of last segment dark, the remainder yellowish; venter of abdomen usually darker in proximity to the ovipositor; in general the coxae and trochanters whitish to yellowish except for the midcoxae which are blackish above; tarsi of all legs somewhat similar, the first four joints testaceous, the apical joint and empodium dusky; coloration of femora and tibiae is variable in degree and extent of infuscation, ground color whitish to yellowish with fuscous or blackish marks as follows: forelegs, femora, apically along the dorsal margin not quite reaching to the knees and beneath at knees, tibiae shortly below knees for about two-thirds the length mostly on dorsal margin, middle legs, femora dorsally and externally on apical half or so, tibiae, basal one-half or so on the outer dorsal side, hindlegs, femora, dorsal margin and sides, tibiae broadly through center base and apex yellowish. *Dimensions:* Length of average-sized specimens 1.6 mm,; length of forewing, 1.2 mm.; width of forewing .5 mm.

The males are quite unlike the females. General color black, submetallic; head refringent, cupreous above to strong greenish on face and cheeks; wings hyaline.

THE MALE

Characters.—Head, dorsal aspect, rather thin, fronto-occipitally more than twice as wide as long (25:11); frontovertex wider than long (11:10), almost one-half as wide as the head (11:25); ocelli forming an angle of almost 90°, the posterior pair about one-half their own diameter from eye margins and same distance from occipital margin, median ocellus placed in front of the center of frontovertex; head, frontal view, almost one-fifth wider than deep (25:21), the transverse measurement taken across the slighly protuberant eyes; antennal sockets located on an imaginary line drawn transversely under the eyes, the sockets a trifle more than their own length apart; scrobes short, hardly more than the length of sockets; antennal scape hardly expanded, short, three times as long as thick; pedicel about one-third longer than thick, not over one-fourth as long as scape and almost as thick; the first funicle joint slightly longer than the following which are subequal; club elongate, about one and two-thirds times as long as the sixth funicle joint (pl. 20, fig. 2 A). Dentition of mandibles similar to that of female. Scutum and scutellum about the same relative width as the corresponding parts of the female; axillae meeting medially. Wings hyaline, postmarginal vein about as long as the stigmal, slightly more than one-half as long as the marginal, as shown in plate 20, figure 2 B and C.

Sculpture.—Frontovertex punctulately shagreened, coarser than that of female; reticulation of face and cheeks not so strongly raised, the cells without pitted appearance of those of frontovertex; setigerous punctures parallel the orbits and are scattered on cheeks and face above oral margin; scutellum appearing granular yet actually pitted, reticulations closer and more strongly raised than those on frontovertex; prepectus and episternum finely lineolate reticulate, the latter more smooth dorsoposteriorly.

Vestiture.—Eyes with sparse microscopic whitish pubescence; punctures of frontovertex, cheeks and face with small blackish and whitish hairs; scutum with posterior two-thirds or so clothed with sparse sword-shaped hairs in addition to the usual hairs; on scutellum a pair of suberect bristles inclined forward, crossing the backward-projecting bristles; abdominal tergites with few fine white hairs; funicle joints of antennae clothed with long curved hairs (pl. 20, fig. 2 A); vestiture of forewings as shown in plate 20, figure 2, B and C.

Coloration.—General color black, submetallic; frontovertex with a cupreous glint; face and cheeks strongly refringent blue-greenish; radicle joint of antenna fuscous, scape and pedicel fuscous to blackish above, soiled whitish beneath; funicle joints and club soiled whitish, suffused with fuscous mostly at extremities; dorsum of thorax mainly dull submetallic, blackish, propodeum in proximity to spiracles, refringent greenish; scutum with a slight greenish luster, posteriorly with a silver gleam due to scattered refractive scale-like hairs; episternum mostly purplish with a tinge of blue green and cupreous, abdomen dark submetallic; forelegs coxae, trochanters, femora, and tibiae pale whitish, the first four tarsal joints somewhat testaceous, apical joint and empodium fuscous; middle legs, coxae fuscous, trochanters and femora whitish, tibiae with a faint fuscous annulus on basal portion; tarsi all whitish, empodium fuscous; hind legs, coxae dark submetallic, trochanters whitish, apical two-thirds of femora dark submetallic, tibiae partly fuscous, ventral margin and broadly at extremities whitish; first four tarsal joints solid whitish, apical joint and empodium blackish. *Dimensions:* Length of average-sized specimens 1.5 mm.; length of forewing 1.2 mm.; greatest width of forewing .6 mm.

Described from 134 females and 16 males (holotype, allotype and paratypes). Specimens reared experimentally on larvae of *Aphycus lounsburyi* How. inhabiting black scales, also additional reared specimens as follows: from citrus cuttings infested with black scale, Duarte, California, 1 female, July 27, 1922, another female, Arcadia, California, 1922; 1 female reared from *Physokermes insignicola* (Craw) parasitized by *Aphycus physokermis* Timb. sent from Santa Maria, California, by R. C. Wiley, October 26, 1922; 6 females reared experimentally on larvae of *Aphycus lounsburyi* How., Whittier, California, May, 1923; 125 females collected on windows of Sierra Madre-Lamanda Park Citrus Association Insectary from brush infested with black scale, collected in the vicinity of Pasadena and Los Angeles, April and May, 1923; 16 males reared experimentally on *Aphycus lounsburyi* How., Whittier, California, May, 1923.

Holotype, allotype, and a series of 10 paratypes are to be deposited in the United States National Museum; in addition a series of 10 paratypes will be deposited in the collection of the California Academy of Sciences, San Francisco, California.

LIFE HISTORY

A few notes were made on the life history of this hyperparasite, among them the following:

A female oviposited in a black scale inhabited by *Aphycus lounsburyi* How. February 28, 1923. Dissection of the newly formed *Aphycus* pupae on March 2, 1923, revealed internal larvae at work. By the fifth the liquid contents of the primaries had been almost consumed as revealed by dissection.

This brief record indicates the rapidity of larval development, but the press of other work prevented further investigation.

OVIPOSITION

After the usual preliminary inspection with her antennae the female mounts the dorsum of the scale and inserts her ovipositor. The organ is used as a probe, being thrust in all directions until a victim is located. The egg is then deposited within the body of the primary inhabitant of the scale. The time taken to oviposit varies; in the case of mature black scale considerable difficulty seemed to be encountered before the female was able to drill an aperture for the insertion of her ovipositor. The penetration of the tough derm seemed to be effected by drilling, the ovipositor being rapidly rotated in one-fourth to one-half turns.

THE EGG

In this stage a curious phenomenon occurs. The eggs grow in size before hatching (see pl. 21, fig. 3). The newly deposited egg is very small, elongate in shape with a short peduncle. Several newly deposited eggs measured .12 mm. in length by .06 mm. through their greatest thickness. As the eggs age they rapidly increase in size, becoming more rotund in shape. The peduncle or stalk does not share in this growth but remains very small and is inconspicuous in the older eggs. Before hatching the perfect larva can be detected through the transparent shell, lying parallel to the longitudinal axis with its tail bent forward and closely appressed to its body.

THE LARVA

A larva dissected from an enlarged sac just before hatching measured 0.6 mm. in length. It was of the motile type, possessing a tail and comparatively large head, quite similar in general appearance to the young larva of *Eusemion californicum* n. sp. Dissections at a later date revealed a larva in a more advanced stage; at least one moult had occurred as a cast skin was adhering to its body. In this stage the tail was greatly reduced and the head of the larva proportionately much smaller.

The later larval and the pupal stages were not observed.

Cheiloneurus noxius n. sp.

Plate 2, figure 4

This species has not yet come into prominence, only four females having been taken.

THE FEMALE

Characters.—Head, frontal view, only a trifle longer than wide; the scrobes rather deep, semi-circular, frontal ledge prominent; antennal sockets rather large, elongate, separated by twice their length; frontovertex about three-thirteenths the width of the head; ocelli in an acute-angled triangle, posterior pair almost touching eye margins; antenna compressed; scape hardly dilated, as long as the sixth funicle joint and club combined, as wide as the fifth funicle joint; pedicel as long as first two funicle joints combined; all funicle joints of about same length; the first two subequal in width, the following gradually widening distally; club short, oblong, about one-third wider than preceding funicle joint, two-thirds as long as scape; ovipositor slightly exserted.

Sculpture.—Frontovertex under low magnification appearing punctulately shagreened, but actually reticulate, area behind posterior ocelli smooth, reticulations almost obsolete; on frontal ledge between an imaginary extension of inner orbital lines, reticulations are transversely drawn out; laterad from inner lower corners of eyes to cheeks frontal ledge is smooth and polished; cheeks with close lineolate reticulations; axillae and scutellum minutely punctulately shagreened, under low power appearing somewhat granular but actually pitted; cells on scutellum somewhat lengthened longitudinally.

Vestiture.—Frontal ledge between inner lower corners of eyes and cheeks set with two rows of whitish hairs; the usual orbital rows present on frontovertex, with addition of some scattered on vertex and a few medio-anteriorly; in addition to the black hairs the first four funicle joints of the antenna are clothed with hairs which produce a silvery appearance; posterior two-thirds of mesoscutum clothed with transparent refractive hairs producing a silver effect, a pair of strong black hairs subdorsally on posterior margin, a number of whitish or silvery hairs scattered about long apical tuft of black bristles on scutellum; vestiture and infuscation of forewings as shown in plate 21, figure 4 B.

Coloration.—Antennae blackish except for a white median stripe on scape, similar to *C. lineascapus;* frontovertex dark metallic; cheeks with strong greenish reflections, in some lights with cupreous glint; frontal ledge between inner corners of eyes and cheeks with strong bluish reflection; face in proximity to mouth parts brownish; occiput and pronotum with black and brownish yellow markings; collar of pronotum with somewhat of a bronze cast; mesoscutum blackish with a transverse band of brownish yellow on anterior third; the posterior blackened area and lateral sides rendered silvery by clothing of refractive hairs; axillae mostly brownish yellow, their bases and sutures blackish; tegulae blackish with brownish suffusion; scutellum brownish yellow, the sides fuscous; ovipositor sheaths brownish; remainder of body dark metallic with reflections as follows: Abdomen with bluish green and purplish, lateral sides of propodeum greenish, episternum purplish; coxae and trochanters of all legs whitish, except for the middle coxae which are fuscous above; femora of forelegs whitish on basal half and at apex, intermediate portion dark brownish, tibiae blackish, ranging to brownish, first four tarsal joints with slightly more brownish than those of other legs, apical joint and empodium fuscous; middle legs with basal two-thirds of femora whitish, apical portion blackish interrupted by an annulated brownish suffusion, tibiae with basal extremity whitish, most of outer margin blackish, remainder ranging to brownish yellow, tarsi same as with forelegs except not quite so brownish; femora and tibiae of hind legs blackish except at basal extremities, which are whitish, the first three tarsal joints whitish, apical two joints and empodium fuscous. *Dimensions:* 1.6 mm.; length of forewing .13 mm.; width of forewing .47 mm.

Described from three females (type and paratypes) collected on windows of Sierra Madre-Lamanda Park Insectary, Pasadena, California, May, 1923.

Type is to be deposited in the U. S. National Museum.

Genus **Eusemion** Dahlb.

In 1913, Timberlake,[2] writing on the parasites of the soft brown scale (*Coccus hesperidum* Linn.) mentioned a rare undescribed species of *Eusemion* which attacked the beneficial *Microterys flavus* (How.). In regard to the species under consideration, he wrote in a letter dated June 29, 1921:

> This is the species I called *Eusemion* n. sp. in my paper and is still undescribed (*loc. cit.*). I have had in mind for a long time to erect a new genus for it and for another undescribed species from Louisiana and for two old world species. It is almost certainly always secondary, and I should judge from the large size of your specimens that they probably came from *Scutellista cyanea* (Motsch). As it probably always consumes the host larvae or pupae leaving only the fine delicate integument and pupates nakedly, unlike *Quaylea* in this respect, it would not be easy in all cases to recognize its secondary habits.

I have no direct acquaintance with the other species included in this genus, nor am I qualified to erect a new genus as Timberlake suggests should be done for the reception of this species. It is, therefore, placed here provisionally.

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[2] Timberlake, P. H., "Preliminary Report on the Parasites of *Coccus hesperidum* Linn. in California," Journal of Economic Entomology, vol. 6, no. 3, pp. 293–303, 1913.

Eusemion californicum n. sp.

Plate 22, figures 5–11

Eusemion sp., P. H. Timberlake, Jour. of Econ. Entom., vol. 6, no. 3, p. 300, 1913.

THE FEMALE

Characters.—Head, dorsal aspect, about twice wider than long; frontovertex about three times longer than wide; vertex at narrowest point two-ninths the width of head; inner orbital lines for much of their length almost straight, diverging moderately posteriorly and anteriorly; ocelli in an acute-angled triangle, posterior pair almost touching the eye margins and about one and one-half times their own diameter from the occipital margin; cheeks not quite so long as length of the eyes; head, from in front, one-sixth wider than deep; eyes reaching downward not quite halfway; face sunken, abruptly meeting frons in a carinated angle; anterior frons or ledge prominent, slightly arched over scrobes, transversely shallowly grooved, smoothly merging into cheeks on the sides; face with a median elevation separating the flat semi-circular scrobes; antennae inserted rather far apart, sockets a little more than their own length from oral margin, and about three and one-half times their own diameter apart; antennal scape very large, compressed laterally, oblong, one and two-thirds times longer than wide, as long as the funicle joints combined; pedicel small, somewhat triangular; funicle joints all very short, transversely expanded, foliaceous; medially, joint one the longest, joint two the shortest, the succeeding joints lengthening progressively; ventral margin of joint one the longest, the following successively shorter; on dorsal margin reverse order is in effect, joint six being the longest, the preceding successively shorter; club large, compressed, about three-fourths as long as scape, apical joint obliquely flattened beneath; mesoscutum not quite twice as broad as long; axillae meeting medially; scutellum as long as the scutum, about one-fourth wider than long, somewhat flattened on the disk, with steeply declivous sides; abdomen about as long and wide as thorax; ovipositor sheaths exserted about one-sixth the length of abdomen; spur of middle tibia as long as the metatarsus; apex of middle tibia and first four tarsal joints with a comb of strong spines or denticles; forewings a little over twice as long as broad; marginal vein about four times as long as thick, obscured by dense integumentary infuscation, post-marginal only slightly produced; stigmal vein, including enlarged apex, about one-half as long as the marginal; submarginal with a gentle downward bend before junction of marginal; infuscation and vestiture shown in plate 23, figure 7 B.

Sculpture.—Frontovertex finely malleate reticulate with a number of scattered punctures, a more or less regular row of them crowded along inner orbits of the eyes; face and cheeks more smoothly reticulate; the frontal ledge with numerous scattered pin punctures; scape of antennae, pronotum, tegulae, and scutum with a coarser pattern of delicate reticulations; axillae more heavily malleate reticulate, the sculpture somewhat intermediate between that of scutum and that of scutellum; scutellum microscopically shagreened with numerous minute, thimble-like punctures when viewed, mounted in balsam, under high magnification, under low power, appearing granular; declivous sides of scutellum microscopically reticulate, under low magnification appearing smooth and polished; metanotum and propodeum lineolately reticulate, the sides of latter much smoother and appearing polished under low magnification; prepectus and episternum finely lineolate reticulate, upper part of the latter becoming more smooth and polished.

Vestiture.—Eyes bare; antennae with numerous coarse short hairs; cheeks and face with a number of downward projecting, short, black hairs, those on the face placed on the median elevation above oral margin; frontal ledge clothed with numerous, conspicuous, long, fine, white hairs; frontovertex with short, black hairs, a more or less regular row paralleling the inner orbits; pronotum and scutum with numerous small, black hairs set in setigerous punctures; axillae and disk of scutellum with sparser and slightly larger hairs; apex of scutellum with two pairs of suberect, larger and coarser bristles; prepectus, episternum, and sides of propodeum destitute of hairs; six long prominent bristles on the submarginal vein, before the downward bend, basad of the heavy browned integumentary expansion.

Coloration.—General color strongly refringent black with bluish, greenish, purplish, and cupreous reflections predominating; scutum less refringent; axillae and disk of scutellum opaque in contrast to the slightly shining scutum; propodeum and declivous sides of scutellum polished, highly refringent, the purples seemingly predominant; frontovertex with strong bluish green reflections; cheeks bluish green above, merging to cupreous below; concealed part of the pronotum and occiput above faintly tinted with brownish; antennae with bluish green, purplish and cupreous reflections; episternum and lateral sides of propodeum highly refringent with purplish reflections predominating; forelegs, apical one-third or more of the tibiae, and faintly under the knees brownish yellow; middle legs, femur with an annulus at base, the tibia with the apical one-half or so brownish yellow; hindlegs, apical one-fourth of tibia brownish yellow; the apical tarsal joints and empodia of all legs, also the metatarsus of hind legs blackish, the remaining tarsal joints yellowish brown. *Dimensions:* Specimens reared experimentally from *Aphycus lounsburyi* How. were surprisingly large, average length 1.7 mm.

THE MALES

The males are unlike the females and are not so common or well known.

Characters.—Head, dorsal aspect, a little more than twice as wide as long; frontovertex about one sixth wider than long and about four-sevenths the width of head; ocelli arranged in an acute-angled triangle, posterior pair a little less than twice their own diameter from occipital margin, and once their own diameter from the eye margins; in frontal view head appears about one-eighth wider than high; angulation between face and frons not carinated as in female; antennae inserted immediately below an imaginary line transversing lower margin of the eyes; their sockets about their own diameter apart, scrobes short and shallow, impressed perpendicularly, rounded above and separated by a slight median elevation; scape slightly expanded, about two and one-half times as long as its greatest thickness; pedicel somewhat globular, as long as wide; funicle joints subequal, not twice as long as wide; club oblong, about two and one-half times as long as wide, acutely pointed at apex; thorax more strongly convex from side to side than that of female; scutum about one-third wider than long; scutellum a little more than one-fifth wider than long; abdomen almost as long as thorax, subtriangular in outline, rounded at basal corners. Wings hyaline, pubescence basad of disk rather sparse, the arrangement shown in plate 23, figure 8 B. Marginal vein about six times as long as wide; post-marginal as long as marginal, about equal in length to the stigmal including the larger apex; veins embrowned except for a hyaline break of submarginal before the junction with marginal.

Sculpture.—Very similar to that of female.

Vestiture.—Except for forewings and antennae, very similar to that of female; fine, whitish pubescence present on face of male, and the hairs clothing frontovertex not quite so strong as in female; apex of middle tibia and first four tarsal joints with a comb of strong spines.

Coloration.—In its entirety, male is less refringent than female; this form entirely lacks the faint brownish tinge of occiput and pronotum; frontovertex, face and cheeks with more or less consistent strong bluish reflections; antennal scape and pedicel blackish, funicle and club fuscous brown; forelegs, apical one-fourth or so of femora brownish yellow, apical one-half of tibiae, and very slightly at base, brownish yellow; the first four tarsal joints more fuscous than those of female; apical joint and empodia blackish; middle legs, trochanters brownish yellow; an annulus at base of femora and both extremities brownish yellow; apical one-half or so of tibiae, and slightly at base, yellowish white; the first four tarsal joints whitish, the fifth joint and empodia blackish; hind legs, the apical one-fourth or so of tibia brownish yellow; metatarsus and apical joint and empodium blackish, remaining tarsal joints brownish yellow. *Dimensions*: Specimens reared from *Aphycus lounsburyi* How. ranged from 1.1 to 1.5 mm. in length.

Described from 102 females and 20 males (holotype, allotype and paratypes), reared experimentally on *Aphycus lounsburyi* How., a primary parasite of the black scale, *Saissetia oleae* (Bern.), and from paratypes reared from *S. oleae* (Bern.) and taken from the following localities in southern California: 3 females, Santa Barbara, October, 1922; 40 females, 5 males, Limoneira Ranch, Santa Paula, August 18, 1921; 40 females, 6 males, Pasadena, May, 1923; 2 females, Chula Vista, November, 1922; 1 female reared from *Coccus hesperidum* Linn., San Diego, 1922; 16 females and 9 males reared experimentally at Whittier, March, 1923. With the exception of one individual from *Coccus hesperidum* Linn. all specimens taken in vicinity of black scale infesting citrus.

Types will be deposited in the U. S. National Museum; paratypes in the California Academy of Science, San Francisco.

NOTES ON LIFE HISTORY

A few fragmentary observations were made on the life history of this secondary parasite. The most noteworthy observation relates to the rapidity with which the larvae develop. My note is as follows:

> Eggs laid March 2 or 3, 1923. Dissection made March 6 revealed the larvae, which had already discarded the tail appendages. Size 1.1 mm. in length by .3 mm. measured through greatest width. Dissection made March 8 revealed full-fed larvae, the host contents having been entirely consumed. These specimens were under laboratory conditions where the temperature averaged 70° F.

Rapidity of development appears to be characteristic of this species also as it is of the other secondaries of the black scale which I have observed. The eggs hatch within two or three days. The larvae completely consume their host and are ready to pupate four or five days later. On the other hand, the primaries require about twelve to fourteen days to complete this same cycle at the same temperature. In the pupal stage the secondaries do not develop much faster than do the primaries; however, the slight advantage gained by rapid larval development enables them to increase at a greater rate than do their hosts, provided the number of eggs deposited by the secondaries is equal to that laid by the primaries.

OVIPOSITION

The female takes a position on the dorsum of the scale with legs slightly braced and exserts the ovipositor. The length of time taken to oviposit is influenced by the toughness or the resistance which the parasite meets in drilling a hole through the derm of the scale. With the individuals under observation, in some instances five minutes or more was spent in drilling before the ovipositor penetrated for an exploratory examination. After the ovipositor is inserted the parasite works the organ in all directions until satisfied of the presence of a primary larva. When a satisfactory primary host is located, an egg is deposited within its body. If the secondary fails to locate a victim, the ovipositor is withdrawn and the female moves to another scale.

THE EGG

The eggs are found floating freely in the body contents of the host. The specimens located by dissection possessed a long stalk, the greater part of which was shriveled and functionless (pl. 24, fig. 9). In one case the shriveled part had separated, leaving a short peduncle in intimate connection with the bulbous enlargement of the egg body. The body of the newly deposited eggs measured .2 mm. in length by .1 mm. through the greatest width. The body of the ovarian egg is slightly smaller than that of the egg after deposition and possesses a long stalk slightly enlarged at the apex. The stalk is almost twice as long as the body.[3]

THE LARVA

A few dissections were made revealing larvae in various stages of development. They are of the motile type and float freely in the fluid contents of the primary larva. The newly hatched larva possesses a long tail appendage (pl. 24, fig. 10 A). In this stage the tail is about one-third as long as the head and the body combined. The integument is thrown into folds and the head is very large in comparison with the body. In a more advanced larva the tail appendage was shriveled and was about to be discarded with the next molt (pl. 24, fig. 10 B). The mature larva does not possess a tail appendage and the head is greatly reduced in proportion to the body. At this advanced stage the primary larva has been almost completely consumed, only the delicate, almost imperceptible integument and the mandibles remaining as evidence of this replacement (pl. 24, fig. 10 B). The head of the mature larva has several minute pore-like openings in the derm on the under side (pl. 25, fig. 11), which serve to distinguish this species from the other inhabitants of the black scale in California.

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[3] It is probable that the eggs grow after deposition after the manner of those of *Eusemion longipennis* Ashm., studied by Timberlake.

THE PUPA

The pupae are found occupying cells fashioned by the larvae of *Aphycus lounsburyi* How., and are easily distinguished by their general resemblance to the adult. When ready to issue, the adults cast the pupal skin and cut an exit hole similar to that made by *Aphycus*. An inspection of the scale will readily show whether or not it was inhabited by a *Eusemion*, as the cast pupal skins are very characteristic.

The parasites of the black scale, *Saissetia oleae* (Bern.), which occur in South Africa are known to be responsible for the scarcity of their host, the scale not ranking as a pest at the Cape, although climatic conditions are favorable for its development. The two species of *Coccophagus* described as new in this paper are supposedly of considerable economic importance as destroyers of the black scale. If judgment may be based on the material which has been sent to California from South Africa, the various species of *Coccophagus* must be given credit for destroying the majority of the black scale. From the material received, it appears that in South Africa the greatest number of these scales are parasitized in the younger stages, only a small proportion reaching maturity.

Coccophagus anthracinus n. sp.

Plate 25, figure 12; plate 26, figure 13.

This form has been examined by both P. H. Timberlake and A. B. Gahan, who have pronounced it undescribed. Mr. Timberlake has generously loaned me his unpublished table to the African species of *Coccophagus,* and this has enabled me to include in my description the characters used by him to separate closely allied species. I am also indebted to Mr. Gahan for notes on *C. immaculatus* How., a species not likely to be confused with *C. anthracinus* n. sp. Since the majority of the species of *Coccophagus* have the body wholly black, this species can be readily distinguished by the hyaline wings, and by the scutellum, which is furnished with three pairs of strong setae. From a somewhat similar undescribed species from South Africa, it can be separated by the antennae, which in *C. anthracinus* has the first funicle joint considerably longer than wide and much larger than the pedicel.

THE FEMALE

Characters.—Head, frontal view, not quite one-fifth wider than high; the eyes about as long as cheeks, pubescence hardly appreciable under ordinary magnification with a binocular microscope; face and cheeks rather coarsely reticulate, reticulations on median prominence of a much finer pattern; scrobes rather deep, the inner margins converging to acute point at intersection of fronto-facial sutures, above this intersection they are rounded; scape when at rest extends slightly beyond fronto facial sutures; a well-defined median suture extends from apex of scrobes to anterior ocellus; genal suture only faintly indicated under eyes; antennal sockets about their own length apart and the same distance above oral margin; head, dorsal aspect one seventh wider than thorax measured at tegulae, a trifle more than twice as wide as long; frontovertex very slightly more than one-half as wide as head, rather coarsely punctulate over a reticulate surface, except occipital margin and basal triangular corners bounded by oblique ocellocular line, orbital line, and occipital margin; ocellar triangle as well as orbits margined by smoother lines; ocelli is an obtuse-angled triangle, lateral pair about one and one-half times their own diameter from eye margins, and a trifle more than one-half times their own diameter from occipital margin; punctulate area of head furnished with short black hairs, a row in more or less regular arrangement on occipital margin and another row paralleling orbits; face and cheeks with numerous short fine hairs.

Antennae moderately stout, fuscous brown, with numerous blackish elevated corneous ridges which project as sharp points beyond apical margins of each funicle and club segment; interspaces between corneous ridges furnished with numerous fine whitish hairs; scape and pedicel conspicuously reticulate, the former with a few short black hairs, those on pedicel longer; scape about as wide as pedicel and not quite so long as club; first funicle joint the largest, one-third longer than pedicel and about one-sixth wider; the succeeding two funicle joints subequal, each about as long as wide, noticeably shorter than the first and a trifle wider; club as long as the last two and one-half of the first funicle joints combined, about one-fourth wider than the distal funicle joint; the first two joints of club subequal in length, as long as the distal funicle joint.

Mesoscutum about twice as wide as long, as long as scutellum, rather coarsely reticulate, clothed with numerous setae somewhat longitudinally arranged, the setae arranged along parapsidal and scuto-scutellar sutures considerably stronger than the others; axillae and scutellum fused with hardly a trace of a dividing suture, reticulations of these lobes not quite so conspicuous as that of mesoscutum; parasites with four setae, axillae with but two; scutellum with three pairs of setae, apical pair the longest, median pair the most widely separated, a pair of large clear punctures on the disk; metanotum with a strong transverse lineolation on either side, and a pair of hairs set in setiferous punctures on anterior margin of either side; propodeum with two sublateral longitudinal carinae, a number of small fine hairs lateral of spiracles; prepectal plates and metapleura rather coarsely sculptured in contrast to the faintly reticulate mesopleura.

Wings hyaline; a small, rounded hairless spot near hind margin on basal third of forewings; submarginal vein a trifle shorter than the marginal; post-marginal shortly produced; the stigmal vein short, not much enlarged at apex.

First abdominal tergite and part of the second mostly smooth and shining; segments from three to six inclusive about as coarsely sculptured as mesoscutum; fifth and sixth tergites have complete row of fine whitish hairs, rows on preceding segments incomplete across dorsum, and entirely wanting on the first segment, apical segment with a number of longer hairs.

Body entirely black, abdomen with faint metallic reflections in some lights; coloration of head variable, in parts from blackish to yellowish with brownish to pallid suffusions; in the light-colored variants face may be yellowish with only trace of fuscous, at other extreme it may be blackish with trace of brown; fronto-vertex blackish, occipital margin and basal triangular corners yellowish to brownish, with a fuscous spot between each lateral ocellus and inner posterior corners of eyes; orbits and ocellar triangle margined by yellowish or brownish lines; scrobes, fronto-facial sutures, and vertical median suture yellowish to reddish brown; cheeks mostly black, sometimes with trace of pallid. Legs blackish, varying to brownish and pallid; front legs with usually a trifle more brownish than the others; femora of front legs becoming more brownish or pallid apically, tibiae and tarsi about concolorous with apex of femora; femora of middle legs with an annulus at base and distal one-fourth pallid or brownish, tibiae tending to be more brownish or pallid at apex, spur whitish or somewhat brownish, tarsi brownish becoming fuscous at apex; femora of hind legs similar but with more black than the middle pair, tibiae black, only brownish or pallid at extreme apex, the two spurs whitish or brownish, tarsi brownish, apical joint fuscous. *Dimensions:* Length of average-sized specimen 1.2 mm.; length of forewing 0.9 mm.; width of forewing 0.4 mm.

Male unknown.

Described from 35 females (holotype and paratypes), reared from the black scale, *Saissetia oleae* (Bern.), at Whittier, California, from material received from Mr. E. W. Rust, who collected the scale-infested cuttings in the vicinity of Cape Town, Union of South Africa. In September, 1923, there was an emergence of 100 *C. anthracinus* n. sp. from material received from Rust. The material consisted of oleander cuttings infested with many live scales which had not been parasitized. The oleanders were placed in moist sand and kept watered so as not to starve the scales until all the parasites had a chance to issue. A great many of the scales continued to live on the cuttings, and the parasites which issued had an opportunity to oviposit before being captured for use in other cages or colonization in the orchards. From the original South African material, about six weeks after its arrival in California, more than 2000 specimens of *C. anthracinus* n. sp. were captured. Apparently these were of a second generation which had developed from eggs laid after receipt of the shipment. The specimens from which the foregoing description was made were of the second generation. Colonies numbering as high as 300 each have been liberated in various districts of California that are infested with black scale.

Coccophagus trifasciatus n. sp.

Plate 26, figure 14 A D

I am indebted to both Mr. Timberlake and Mr. Gahan for pronouncing this species as undescribed. This is a small black and yellow form with hyaline wings, the scutellum about as wide as long and furnished with ten or twelve short setae more or less scattered. According to Timberlake's unpublished table, it ranges close to *C. nigropleurum* Girault, but is quite different in coloration.

THE FEMALE

Characters.—Head, frontal view, about one sixth wider than high; the eyes moderately small, convergent and somewhat angular below, reaching downward about one-half way, the pubescence microscopic; scrobes grooved rather deeply so that scape is completely received when at rest; antennae inserted slightly below basal line of the eyes; face and cheeks clothed with fine, microscopic, whitish hairs, those above oral margin larger; the sculpture appears finely granular alutaceous in the tag-mounted specimens; frontofacial sutures well defined. Head, dorsal aspect, slightly more than twice as wide as long; frontovertex occupying about five-ninths the width of head; ocelli in an obtuse-angled triangle, lateral pair twice their own diameter from eye margins, and about one-half their own diameter from occipital margin, median ocellus placed slightly behind center of frontovertex; eyes very narrowly separated from occiput; sculpture of head appears punctulate over a finely reticulate surface.

Antennal scape not quite so long as pedicel and first two funicle joints combined; pedicel one-third longer than wide, longer than succeeding joint; funicle joints all gradually increase in width distally; the first two are about as wide as long, the second a trifle larger than the first; the third joint is a trifle shorter than the second, and very slightly wider than long; club elongate ovate, about as long as all the funicle joints combined, and about one-sixth wider than preceding funicle joint; flagellum and club with numerous raised corneous ridges.

Scutellum about as wide as long with suture separating it from the axillae easily traceable, furnished with ten to twelve or in some specimens thirteen setae, there being an apical, a preapical, and a premedian pair which are larger and nearly always distinctly paired, and in addition from five to seven smaller setae scattered before and between the premedian paired setae; pronotum and mesoscutum with numerous black setae, those along the parapsidal furrow a trifle stronger than the others; setae of mesoscutum somewhat seriately aligned; parapsides with four setae, and axillae with two, these being as large as those scattered on scutellum; metanotum with about four wavy striations on the sides, and furnished with two small hairs in setiferous punctures on anterior margins of either side; propodeum with two strong sublateral carinae a short distance in from spiracles, area between carinae with microscopic striations, the sides with a network of microscopic lines; from above spiracles three or four hairs extend laterad to group of hairs scattered on sides; blackened portions of the mesoscutum, axillae and scutellum covered with a network of reticulations as seen in balsam. Submarginal vein of forewing as long as the marginal; the post-marginal not produced; stigmal short, not enlarged at apex.

Abdomen about as long as thorax, the sides subparallel for greater part of length, what appears to be the first and second segments fused without a traceable suture, these two occupying about one-third the length, the apex bluntly rounded; blackened areas of abdomen appear to be a trifle more coarsely sculptured than blackened areas of mesonotum; the sides of second, third and fourth tergites with only a few small black hairs in transverse alignment, the fifth and sixth with a complete transverse row across dorsum, apical tergite with a median semicircle and a few stronger scattered hairs; ovipositor enclosed by a projecting lobe of the last ventrite, both ovipositor and hypopygial structure curved upward at apex but not projecting beyond abdomen.

Head yellowish to brownish, dorsum suffused with a variable amount of dusky, occiput liberally marked with blackish, tips of mandibles brown, antennae yellowish brown; pronotum blackish, the sides sometimes tinged with yellowish; anterior one-third of mesoscutum blackish, the remainder as well as parapsides, tegulae, and prepectal plates yellowish; scutellum blackish, sometimes the lateral sides with a blotch of yellowish; axillae, metanotum, propodeum, and metapleura black; mesopleura ranging from blackish to yellowish; venter of thorax and abdomen mostly yellowish; first abdominal tergite yellow with a black spot on either basal corner, second segment blackish on or about posterior third, the following two segments entirely blackish on dorsum, the fifth blackish medially, and yellowish laterally, the sixth and seventh mostly yellowish medially and blackish on the sides; legs mostly yellowish; hind tibiae blackish on or about the basal two-thirds; coxae of hind legs black basally; femora and tibiae of front and middle legs slightly suffused with dusky; all tarsi more or less infuscated. *Dimensions:* Length 0.9 mm.; length of forewing 0.65 mm.; width of forewing 0.3 mm.

THE MALE

Characters.—Aside from sexual differences, male differs from female mostly in coloration. Body black except for tegulae, a large part of the parapsides, and a spot on pleura close to root of forewings which is yellowish; tegulae sometimes marked with a black dot; face and legs except a large part of hind tibiae bright yellow. Eyes a trifle smaller than in the female so that antennae are inserted about midway between oral margin and a line drawn under anterior orbits; abdomen shorter than thorax.

Described from seven females and six males (holotype, allotype and paratypes), reared from *Saissetia oleae* (Bernard), infesting oleander cuttings received from Mr. E. W. Rust who, presumably, collected the material in the vicinity of Cape Town, Union of South Africa.

In addition to the specimens preserved for descriptive purposes, several hundred living adults have been handled at various times during the past two years. One small colony was placed in an orchard infested with black scale at Covina, California. As yet, none has been recovered from this locality, and it is supposed that they failed to become established. The failure of these parasites to propagate in the laboratory has been due to lack of males at the proper time. One lot of virgins reproduced freely but their progeny were all of the male sex, and in the meantime the parents had all succumbed. A few notes on the habits of this species were made. Egg laying commences soon after the females issue from the scales. When confined in a vial and provided with black scale, it was found that the selection of a host was rather indiscriminate, very small forms as well as larger 'rubber-sized' individuals being selected for attack. However, field observations may show that this species has a marked predilection for a certain sized scale. The act of oviposition was very rapid, the parasite only momentarily pausing by the victim during the act. Unlike the other species of *Coccophagus* which have been observed by me, this parasite takes a position by the side of the victim and not on its dorsum. In position it faces outward with the apex of the abdomen directed toward the scale. The short ovipositor is exserted and an egg is thrust through the derm of the victim. The eggs are found floating in the fluid contents of the host. They are elongate in shape, measuring 0.075 mm. in length by 0.025 mm. through their greatest thickness. The larval stages were not noted.

EXPLANATION OF PLATES

PLATE 20

Cheiloneurus inimicus n. sp.

Fig. 1. Female. A, forewing; B, head, frontal view; C, mandible; D, venation of forewing; E, antenna.

Fig. 2. Male. A, antenna; B, forewing; C, venation of forewing.

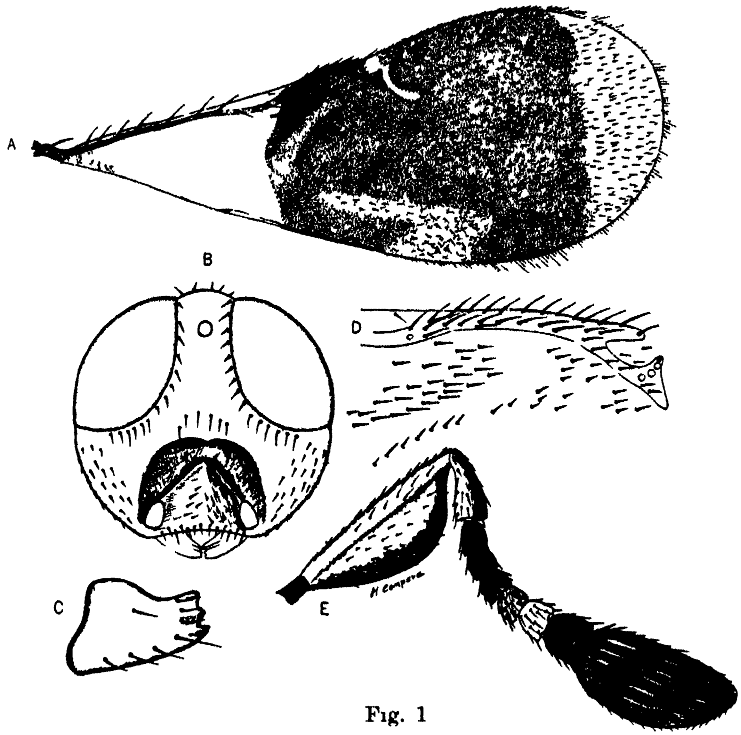

Fig. 1

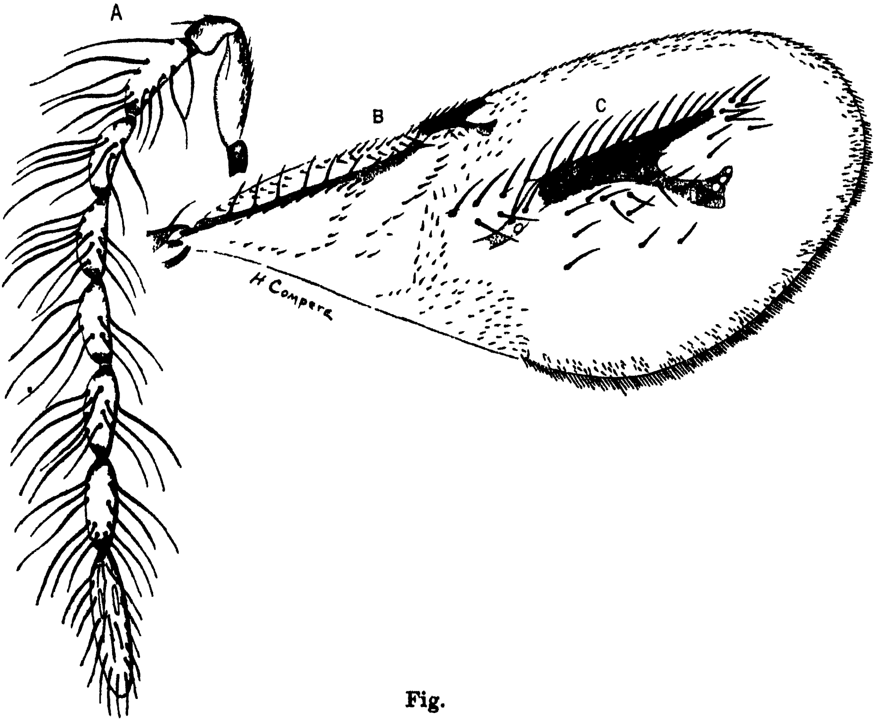

Fig.

PLATE 21

Fig. 3. *Cheiloneurus inimicus* n. sp. Eggs and larvae. A, ovarian egg; B, newly deposited egg; C, egg in process of growth; D, egg just before hatching, showing larva within; E, first stage larva; F, partly grown larva with moult skin adhering.

Fig. 4. *Cheiloneurus noxius* n. sp. Female. A, antenna; B, forewing.

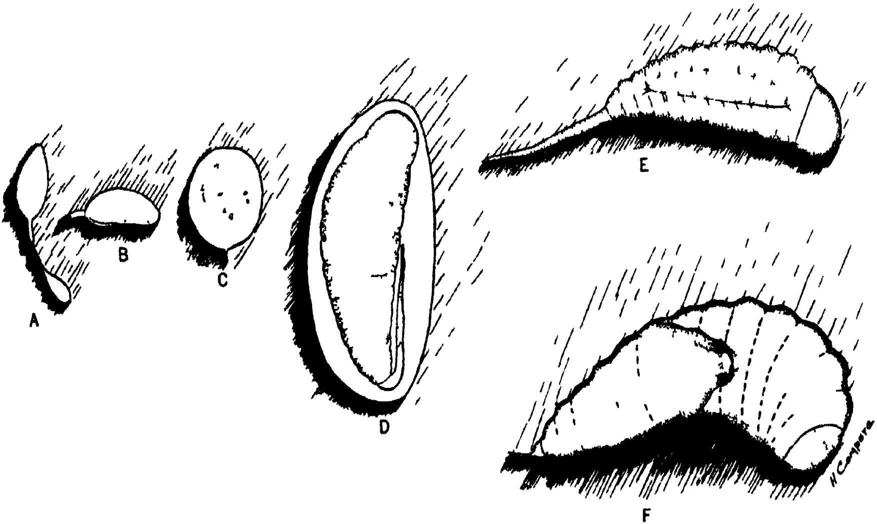

Fig 3

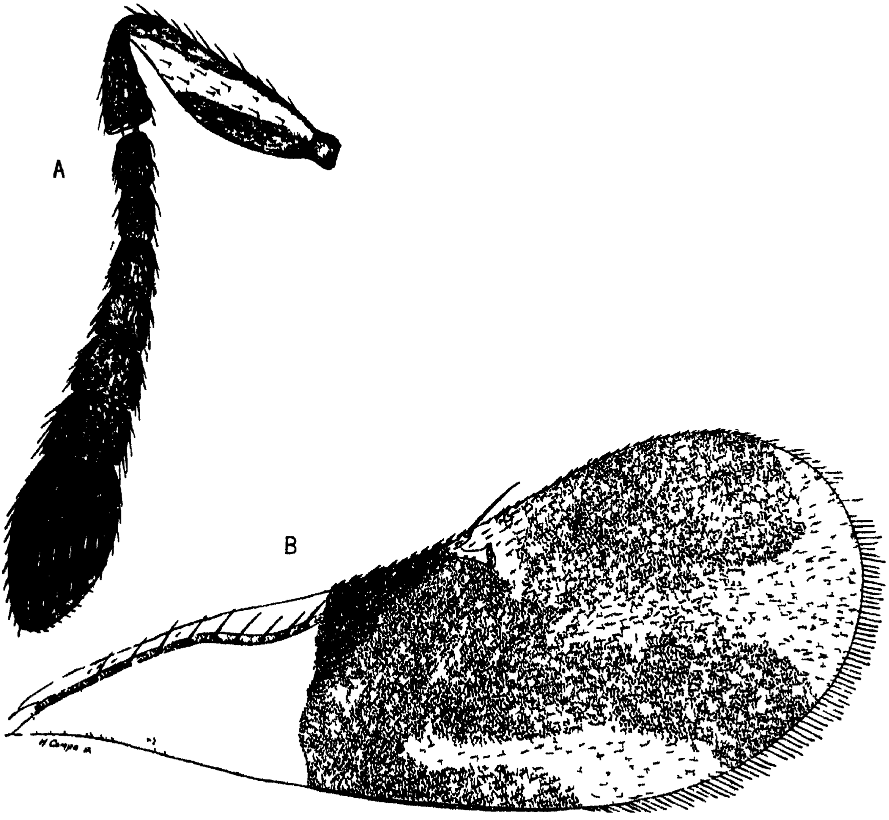

Fig. 4

PLATE 22

Eusemion californicum n. sp.

Fig. 5. Female approaching a black scale. (Photograph, courtesy of the Los Angeles Examiner.)

Fig. 6. Female.

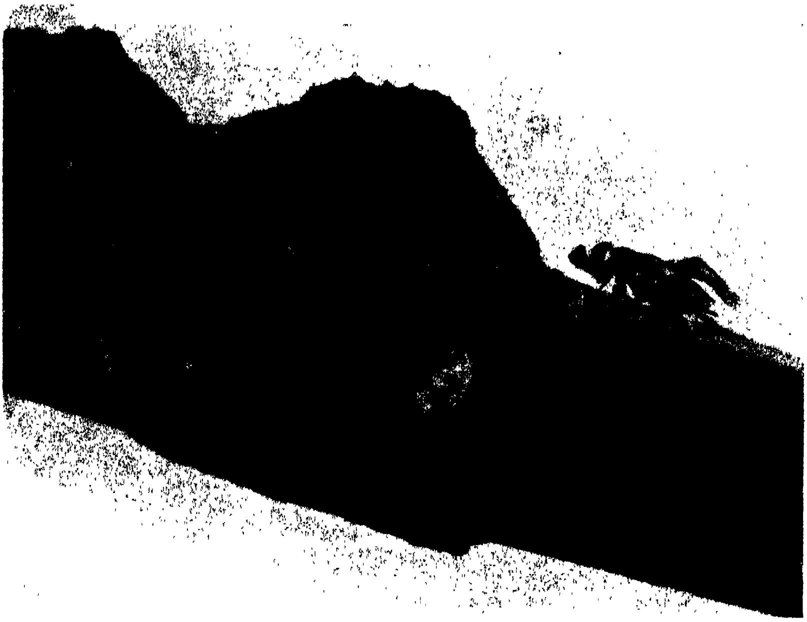

Fig. 5

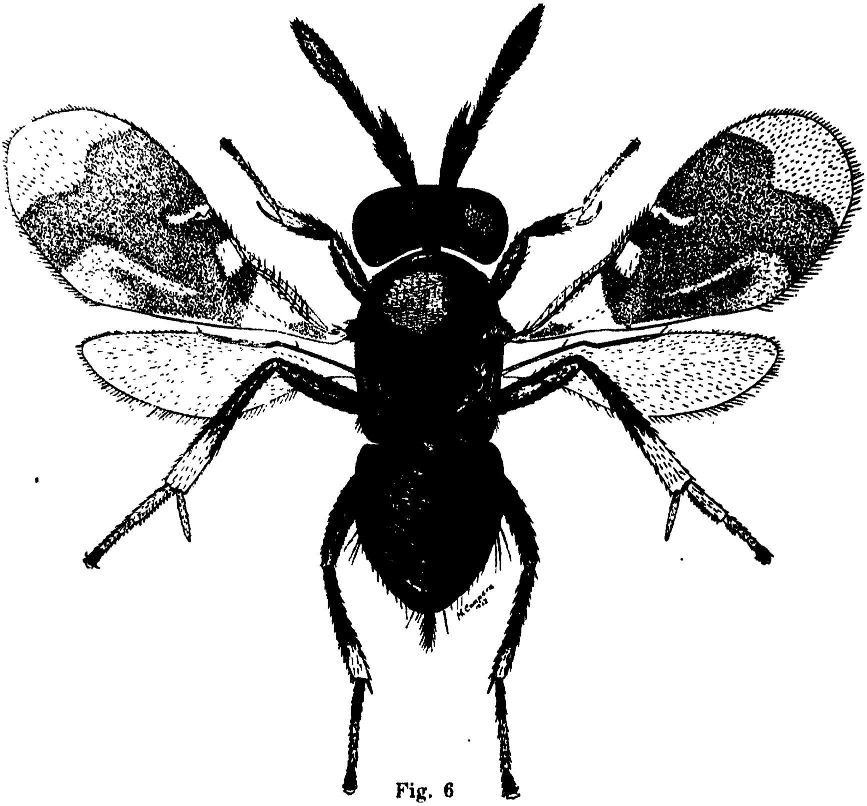

Fig. 6

PLATE 23

Eusemion californicum n. sp.

Fig. 7. **Female.** A, antenna; B, forewing; C, head; D, stigmal vein; E, mandible; F, cutting edge of mandible.

Fig. 8. **Male.** A, antenna; B, forewing; C, insert of stigmal vein.

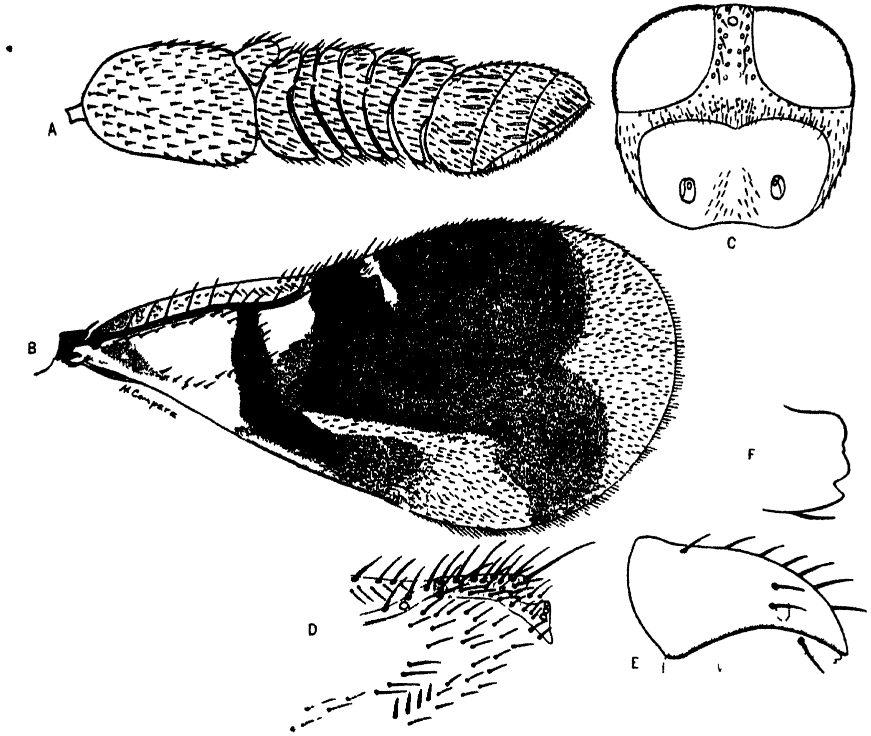

Fig. 7

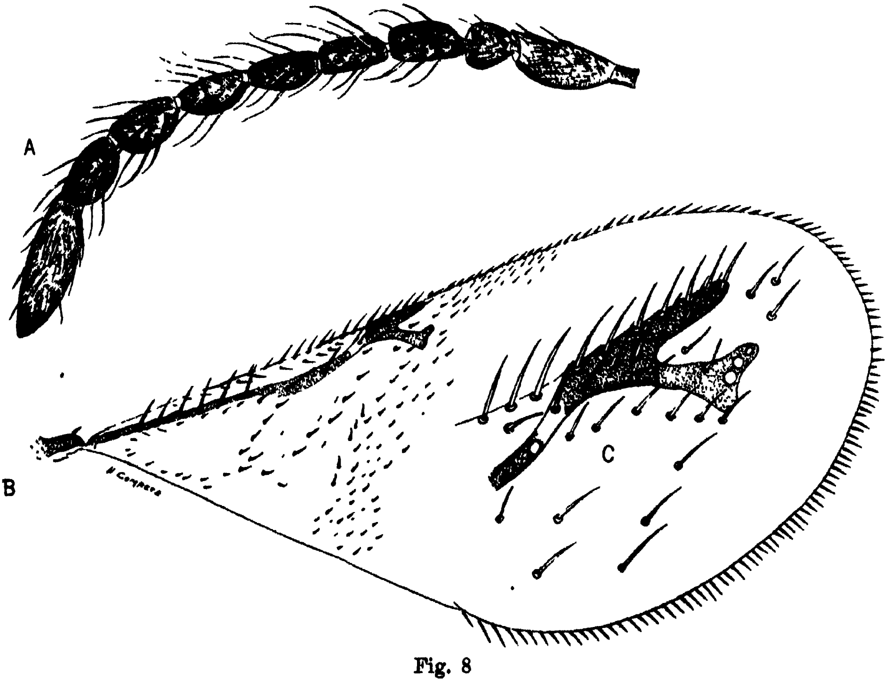

Fig. 8

PLATE 24

Eusemion californicum n. sp.

Fig. 9. Egg before and after oviposition.

Fig. 10. A, B, C, larva in successive stages of development.

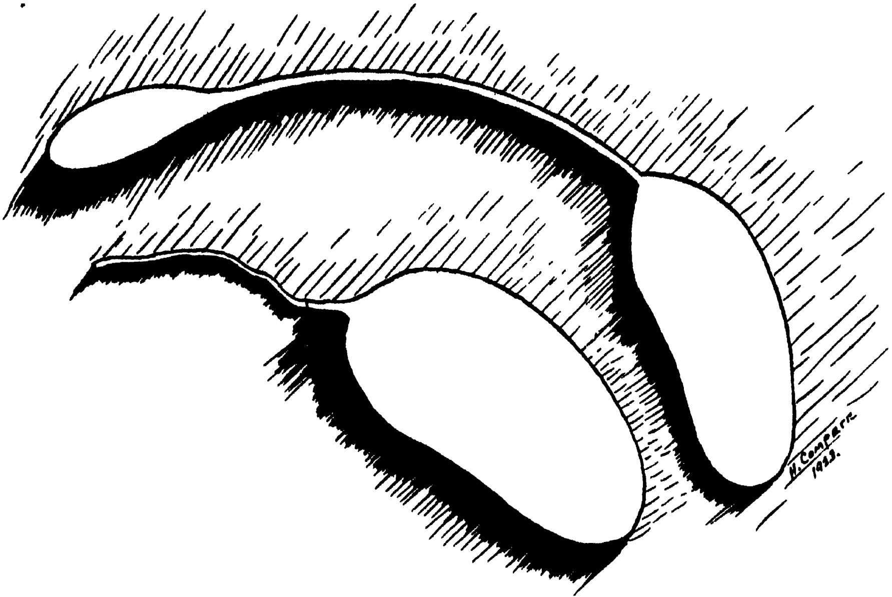

Fig. 9

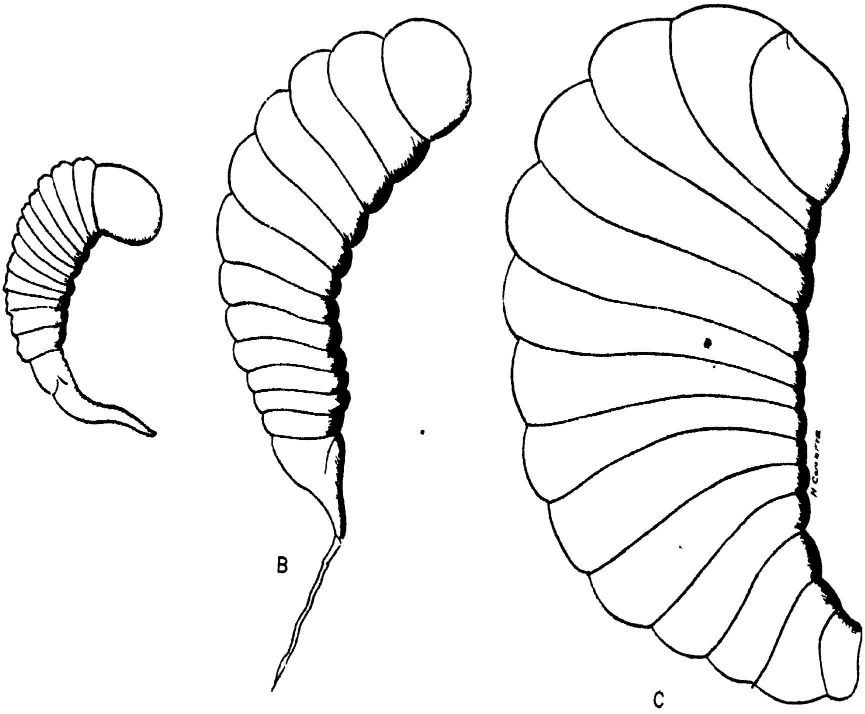

Fig. 10

PLATE 25

Fig. 11. *Eusemion californicum* n. sp. Head of mature larva, vential aspect.

Fig. 12. *Coccophagus anthracinus* n. sp. Female. Thorax, and knee of middle leg.

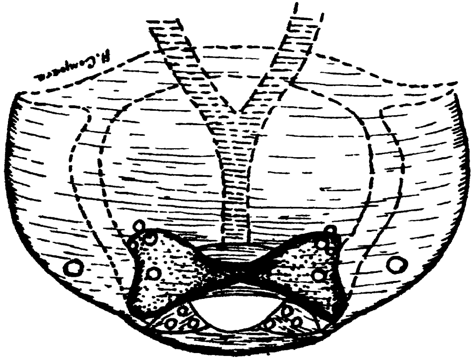

Fig. 11

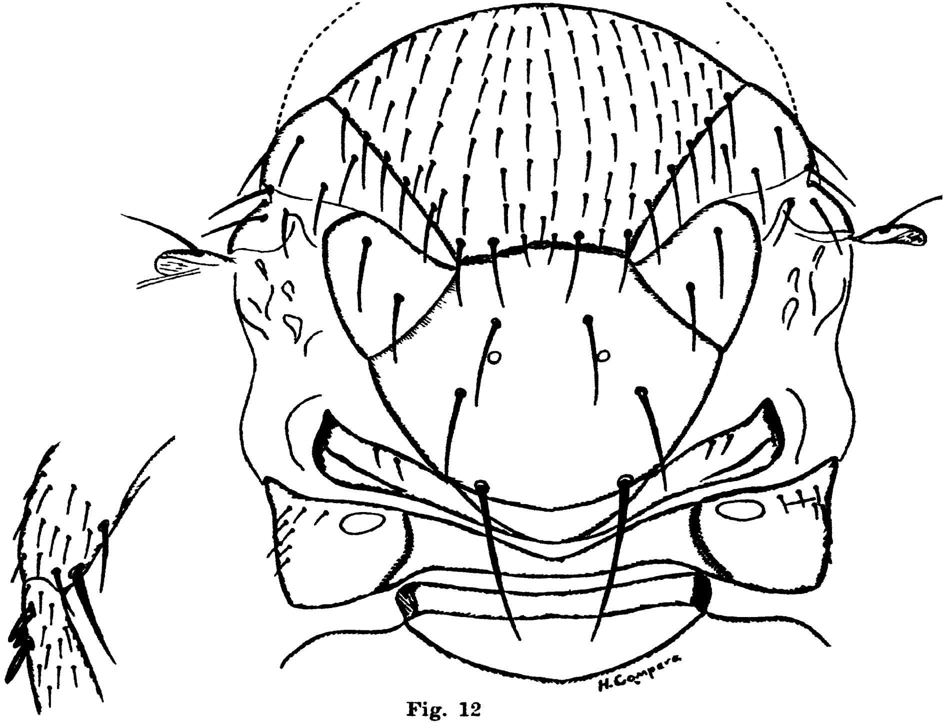

Fig. 12

PLATE 26

Fig. 13. *Coccophagus anthracinus* n. sp. Female, forewing and hind wing.

Fig. 14. *Coccophagus trifasciatus* n. sp. A, female, antenna; B, female, thorax and abdomen; C, male, head, dorsal aspect; D, female, forewing.

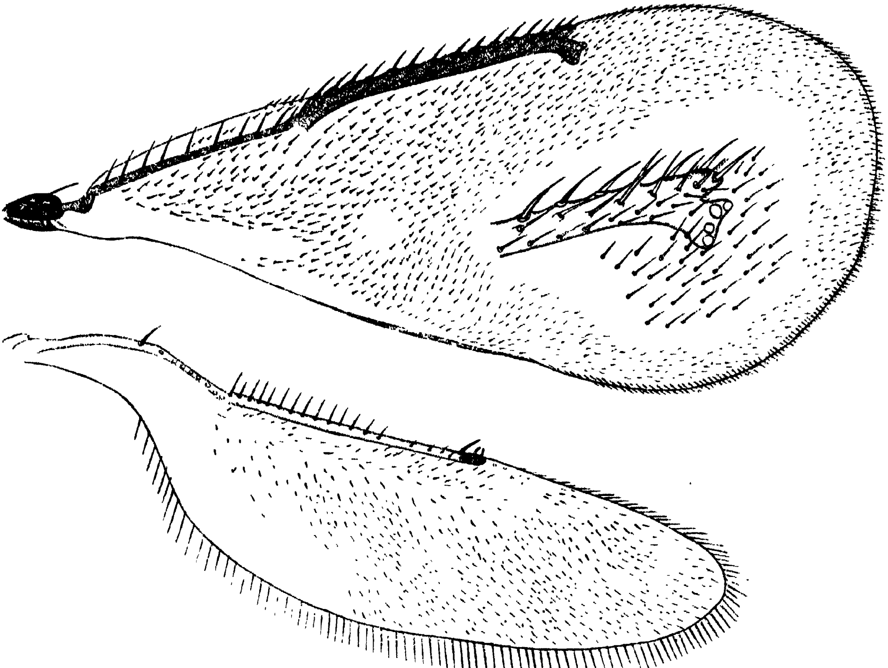

Fig. 13

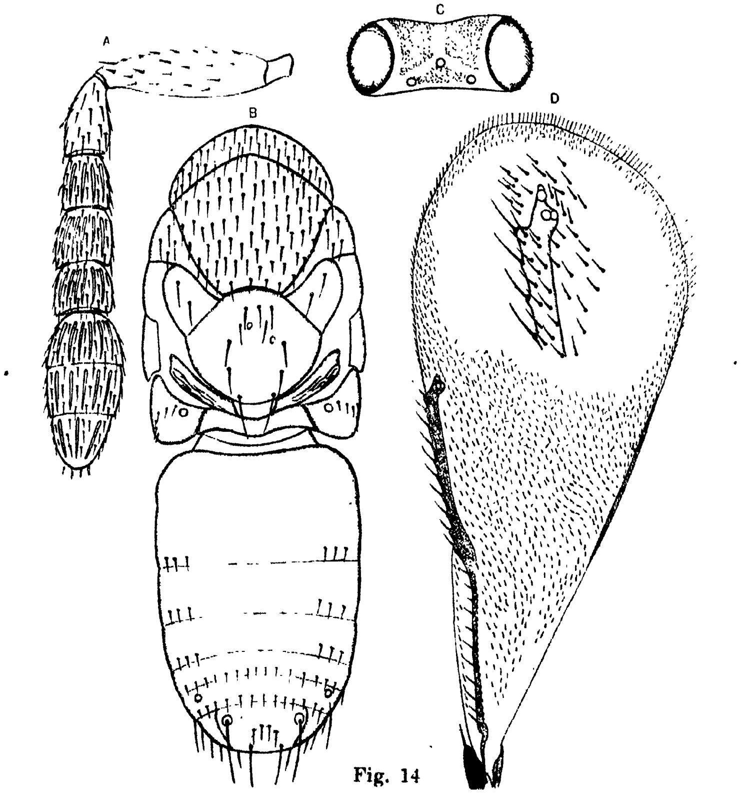

Fig. 14

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ON A COLLECTION OF PSEUDOSCORPIONS FROM THE STOMACH CONTENTS OF TOADS*

BY

JOSEPH CONRAD CHAMBERLIN

Through the kindness of Dr. R. V. Chamberlin of the Museum of Comparative Zoology I have had the opportunity of examining an interesting collection of pseudoscorpions taken from the stomach contents of toads (*Bufo*) in various parts of the country. This collection was made by the U. S. Biological Survey at Washington in the course of their investigation on the food of toads.

Hyarinus gen. nov.

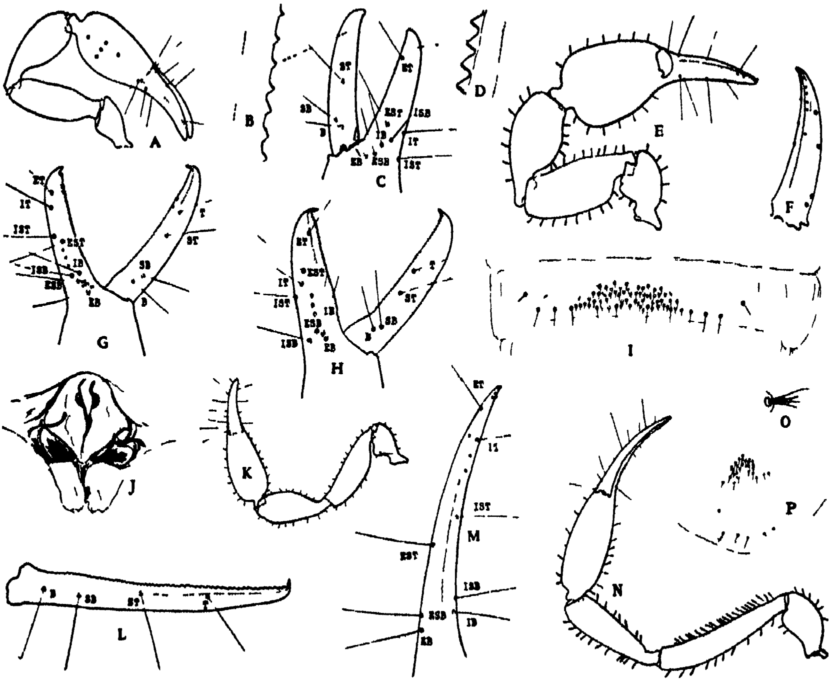
Orthotype.—Hyarinus hesperus sp. nov. California.

Diagnosis.—Obisioid genus in which the fourth femoral articulation is strongly oblique; first femoral articulation perpendicular and of subimmobile type, the pars basalis comprising more than a third the total length of the femur, although distinctly shorter than pars tibialis; poison duct presumably of short type and present in fixed finger only; flagellum of six slender, more or less pinnate blades; pleural membrane evenly plicate; T of movable finger apparently absent; cluster of 5 pseudotactile setae on dorsum of claw (fig. A); general chaetotaxy of claws as figured (fig. C); carapace rounded anteriorly and bearing two distinct pairs of eyes, anterior pair of which is about their own diameter from anterior margin, with second pair less than their own diameter from first pair; carapace and tergites undivided, smooth, and indistinctly tessellated; appendages smooth and almost polished; setae all completely simple; tergal and sternal setae weakly developed, apparently but 4 border setae to each tergite and sternite.

---

* Paper No. 123, University of California, Graduate School of Tropical Agriculture and Citrus Experiment Station, Riverside, California.

Remarks.—The affinities of this interesting genus are noted under the specific heading. So far as known the only species here referable at present is the orthotype.



Figures A–P

Hyarinus hesperus sp. nov. ♀. Holotype. A, Dorsal aspect of left palpus. The areoles for the insertion of the five "pseudotactile setae" of the hand only are shown, the setae themselves being broken. B, Marginal teeth from near tip of movable finger. C, Interior aspect of right claw showing the chaetotaxy. D, Marginal teeth from near tip of fixed finger.

Chernes peninsularis sp. nov. ♀. Holotype. E, Ventral aspect of right palpus. F, Dorsal (vertical) aspect of movable finger, showing poison duct and accessory teeth. G, Interior aspect of left claw, showing chaetotaxy, marginal and accessory teeth sense spots and poison duct.

Withius vagrans sp. nov. ♂. Holotype. H, Exterior aspect of right claw showing chaetotaxy, sense spots and poison ducts. I, Seventh ventrite showing chaetotaxy and median cluster of microsetae. J, General aspect of male genitalia (ventral aspect). K, Dorsal aspect of left palpus.

Zaona biseriatum (Banks). ♀ JC—532.02001. L, Inner aspect of movable finger of left claw showing chaetotaxy and poison duct. M, Ventral (vertical) aspect of fixed finger of left claw showing chaetotaxy and marginal and accessory teeth. N, Ventral aspect of right palpus. O, Tergal seta. P, Vulva of female. Seminal receptacles indicated by dotted lines.

Hyarinus hesperus sp. nov.

Figures A, B, C, D

Holotype.—♀, JC—532.05001. "Identification card No. 822, Bufo #, Santa Barbara, California." The holotype and only known specimen is in very poor condition.

Diagnosis.—Palpus of form figured (fig. A); claw with chaetotaxy as figured (fig. C); marginal teeth of fixed finger of claw 33–35, small and conical in shape and slightly less than their own width apart (fig. D); movable finger with 30–32 evenly spaced, smaller conical teeth, their own width or more apart (fig. B).

Measurements.—No measurements of legs or accurate measurements of chelicerae obtainable. Total length, 2.7 mm. K, 0.65 mm. Carapace (1.28–0.74, 0.95). Chelicera (only approximate), (0.43–0.23, 0.31). Palpus (coxae unknown) (0.62–0.32) (1.00–0.35) (1.05–0.43) (1.75–0.58) (0.88–0.26).

Remarks.—This species is similar in several respects to the species described by Banks as "*Ideoroncus*" *obscurus.* They cannot well be confounded with one another, and both are widely separated from any other known species.

Bank's *obscurus* is no doubt generically distinct from *Hyarinus* and, likewise, is widely separated from true *Ideoroncus* by many fundamental morphological characters. Consequently a new genus is here erected for its reception.

Syarinus gen. nov.

Orthotype.—*Ideoroncus obscurus* Banks. Pacific Coast of United States of America.

Diagnosis.—Obisioid genus closely related to *Hyarinus;* structurally similar thereto except that no traces of eyes or eyespots are present; full complement of tactile setae of movable finger present, T being submedian and scarcely its diameter removed from ST; general chaetotaxy of claw distinctly different from that of *Hyarinus;* no indication of the five pseudotactile setae on dorsum of hand as is the case in *Hyarinus;* marginal teeth of fingers of claw clearly contiguous, and not spaced as in *Hyarinus.*

Remarks.—Other differences will no doubt be apparent as soon as good material of *Hyarinus* becomes available and a complete description can be written. The structure of the femora of the legs in these two genera renders confusion with any other known "Obisioids" impossible.

Syarinus obscurus (Banks)

1893. *Ideoroncus obscurus* Banks. Can. Entom., vol. 66.
Previously recorded from California and Washington. It has also been recorded from Montana but this record is open to serious doubt.

Material Examined.—Paratype from Olympia, Washington, ♀, JC—17.01002. "Pacific Coast," unknown locality, ⊙, JC—18.02001 from the Museum of Comparative Zoology. Yolla Bolly Mountain, Mendocino County, California, ♀, JC—16.01001, collected on fur of *Microtus constrictus* by G. F. Ferris. San Gregoria Beach, San Mateo County, California, 7 or 8 females (JC—19.01001—7 or 8) from under bark of live oak (*Quercus agrifolia* Neé) log on beach, March 20, 1921, collected by Carl D. Duncan and the author. Berkeley, California, ♀, JC—32.02001, collected by Dietrich.

Remarks.—An undescribed species of this genus, closely related to *obscurus*, is at hand from Colorado. It is interesting to note that out of a rather large series of specimens of the two species, not a single male appears. It is also noteworthy that in both species the spinneret of the immature specimens is composed of a large, basally divided, compoundly ramose galea, while in the adult it is reduced to a small, simple, or slightly branched stylet.

Garypus californicus Banks

Material.—Three badly damaged females (JC—332.01001 —3). "Santa Barbara—California. Identification card No. 832 Bufo Δ." From the stomach of a toad, *Bufo* sp.

Chernes peninsularis sp. nov.

Figures E, F, G

Holotype.—♀, JC—532.04001. "Identification card No. 1149, *Bufo* Δ. Cape San Lucus, Lower California, Mexico." The fragmentary holotype (minus most of abdomen and legs) is the only known specimen.

Diagnosis.—Indistinct eyespots present; anterior carapacal furrow slightly nearer posterior than anterior margin; posterior furrow slightly nearer posterior border than anterior furrow; palpus as figured (fig. E); tactile setae and poison ducts as figured (figs. G, F); movable finger with 48 or 49 subconical, slightly retrorse, contiguous marginal teeth; with 2 exterior accessory teeth anterior to nodus ramosus, and 3 interior accessory teeth, the first of which is about even with the posterior tooth of exterior series, all subequally spaced; fixed finger with 47 similar marginal teeth; with 3 exterior accessory teeth even respectively with the 2d, 7th and 9th marginal teeth, interiorly with 6 accessory teeth, subequally spaced, extending posteriorly almost half the length of the finger; fixed finger with 3 interior longitudinally spaced sense spots between IST and ISB; and 3 exterior similarly spaced sense spots lying between EST and ESB, as well as with a basal exterior group of 6 or 7 spots (fig. G); flagellum of 3 blades, the anteriormost of which is longest and anteriorly dentate; about 14 to 16 setae, 4 lyrifissures and 45–50 microlyrifissures per tergite; palpal setae rather short, stout, non-clavate, and distally slightly dentate; other setae lost; 18 teeth in serrula exterior, cheliceral setae lost.

Measurements.—Total length about 3 mm. K, —0.83 mm. Carapace (1.26–0.66, 1.13). Chelicera (0.42–0.21, 0.30). Palpus (0.65–0.42, 0.54–0.48) (0.66–0.39) (1.00–0.43) (0.99–0.47) (2.10–0.66) (0.90–0.26) Leg I (0.30–0.46, 0.43–0.50) (0.27–0.22) (0.30–0.24, 0.50–0.22) (0.57–0.15) (0.51–0.10). Leg IV (0.33–0.28, 0.42–0.30). (Remainder of leg lost.)

Remarks.—In spite of the mutilated condition of the only known specimen of this species, there is little doubt as to its being truly congeneric with *C. cimicoides* Fabr. of Europe, the genotype of *Chernes*. It is certainly not a *Hesperochernes*.

Zaona gen. nov.

Figures L, M, N, O, P

Orthotype.—*Chelifer biseriatum* Banks. Florida.

Diagnosis.—Related to *Chernes* and *Hesperochernes* from which it may be immediately distinguished by the very slender, non-pedicellate, Chelifer-like palpi (fig. N); flagellum of 3 blades as in *Chernes*; chaetotaxy of chelicera as in *Chernes*; chaetotaxy of claw as figured (figs. L, M); 3 or 4 accessory teeth on fixed finger only (fig. M); poison duct extending almost even with ST of movable finger (fig. L); interscutal and intersegmental membrane longitudinally wrinkled but scarcely rugose; pleural membrane slightly and rugosely wrinkled; carapace posteriorly as broad as long; with two distinct eyespots or perhaps weakly developed real eyes; both carapacal furrows distinct but not prominent; 12–14 tergal and sternal border setae per segment; tergal setae smoothly and broadly clavate (fig. O); sternal setae completely simple; palpal and pedal setae short and stout but not clavate; female genital area and seminal receptacles as in *Chernes* (fig. P).

Remarks.—The orthotype is the only species at present referable to this interesting and comparatively isolated genus.

Zaona biseriatum (Banks)

Figures L, M, N, O, P

1895. *Chelifer biseriatum* Banks, Jour. N. Y. Entom. Soc., vol. 3.

Previous records.—The type locality is Lake Poinsett, Florida. Banks has also recorded it from Punta Gorda, Florida, and Berger from Berea, Ohio. This last record is very doubtful and probably incorrect.

Material Examined. — Two badly damaged females (JC—532.02001–2) from "Sebastian Florida, 2–11–19 A.W." Presumably not from the stomach contents of toads, at least not so labeled. Through the courtesy of the authorities of the Museum of Comparative Zoology I have also had the opportunity of examining a series of Banks' paratypes.

Remarks.—It was the slenderness of the palpi, no doubt, which led Banks to erroneously refer this species to *Chelifer* instead of "*Chelanops.*" The accompanying figures will permit positive specific determination.

Withius vagrans sp. nov.

Figures H, I, J, K

Holotype.—♂, JC—532.03001. "Identification card No. 2314, Bufo ⊙, Brownsville, Texas." The holotype and only known specimen is in good condition.

Diagnosis.—Palpus as figured (fig. K); chaetotaxy and poison ducts of claw as illustrated (fig. H); with 2 true eyes; anterior carapacal furrow almost median, posterior furrow nearer posterior margin than anterior furrow; sides of carapace subparallel, beginning to converge just behind the eyes; tergal chaetotaxy 10:10:10; $\frac{0\text{-}2\text{-}0}{10}$; $\frac{2\text{-}2\text{-}2}{8}$; $\frac{2\text{-}2\text{-}2}{9}$; $\frac{2\text{-}2\text{-}2}{9}$; $\frac{2\text{-}2\text{-}2}{8}$; $\frac{2\text{-}1\text{-}2}{8}$; $\frac{2\text{-}2\text{-}2}{4}$; ventral chaetotaxy about as figured (fig. I); the median cluster of microsetae found on the 3d to 10th segments, although reduced in size and distinctness on 3d and 10th ventrites; last ventrite with many microlyrifissures; male genitalia as figured (fig. J); tergal seta short and broadly spatulate; ventral setae short, acuminate; palpal setae short and thick, not spatulate.

Measurements.—Total length, 2.15 mm. K, 0.58 mm. Carapace (1.21–0.52, 0.83). Chelicera (0.33–0.21, 0.28). Palpus (0.59–0.35, 0.47–0.42) (0.59–0.31) (1.00–0.31) (0.99–0.38) (1.46–0.45) (0.66–0.17). Leg I (0.31–0.40, 0.43–0.45) (0.23–0.24) (0.31–0.24, 0.75–0.31) (0.73–0.17) (0.54–0.10). Leg IV (0.10–0.24, 0.43–0.33) (0.21–0.19) (0.19–0.24, 0.44–0.23) (0.50–0.14) (0.45–0.08). Depth of claw 0.44.

Remarks.—It is possible that some of the "*Chelanops*" described from Texas and other southern states (for example *C. texanus* Banks), are really Withiine forms, in which case it is possible that this species will fall as a synonym of one of them. Until they are redescribed, however, no safe decision on this point can be rendered.

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THE MOSQUITOES OF CALIFORNIA

BY

STANLEY B. FREEBORN

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INTRODUCTION

The mosquitoes of California are divided into three main groups: (1) the salt marsh breeders, which have become veritable pests along the coastal area; (2) the mountain breeding *Aëdes*, which constitute the most serious obstacle to the full enjoyment of the High Sierra; and (3) the malaria-carrying anophelines, which are responsible for the endemic foci of malaria in some parts of the central valley.

Following the fundamental studies regarding the transmission of malaria and yellow fever by mosquitoes, interest in the Culicidae has brought forth many valuable and painstaking papers on their taxonomy, life-history, and control. In several treatises the Californian mosquitoes were described or mentioned as a part of a more extensive fauna, and consequently without the specific treatment that their peculiar ecological conditions warrant, although it should be noted that lists were published by Quayle (1906) and Herms (1917).

Taxonomic work, too, has progressed so rapidly during the past few years that, unless the reader has followed its vagaries, the interpretation of modern references by means of even comparatively recent monographs becomes a confusing and almost impossible undertaking.

What original taxonomic work this paper includes is based on a sorting of the valid species from the synonyms, and a pointing out of the minor differences which we are forced to accept between closely allied species. The trinomial system of nomenclature has been used in some cases to show the relationship existing between races of species. Slight differences, it is recognized, are of extreme interest to the general biologist; but, if a separate species is established for each variant, the relationship is as obscure to him as though the differences had never been noted and the race left as a part of the original species.

The statements relative to the distribution of the various species in California are based somewhat on the author's experience in actual control work, which has taken him to the various mosquito abatement districts located in all sections of the State; but are more largely based on the results of an extensive mosquito survey made by Professor W. B. Herms, of the University of California, and the writer. This work, which occupied three summers, was financed by the California State Board of Health and the University of California. The work involved 15,000 miles of travel by automobile throughout every county in the State and three trail trips into the High Sierra. Collections were made at every available point, averaging one for every three miles of travel. The collected mosquitoes were mounted, determined, and the results tabulated on cards for each collection. This information is now available in card form and on pin maps at the University. The inclusion of separate specific records would be too bulky for a work of this kind, and, for this reason, the distribution is stated in general terms except for the rarer species.

The descriptive data are based on the examination of a set of characters known to be of taxonomic interest and from a large series of specimens except where the contrary is stated. In this way it has been possible to eliminate considerable material which would be of no great aid in the determination of the fauna under discussion and would inevitably delay and confuse the inexperienced. The use of large series of both larvae and adults has made it possible to point out the variable characters. These variations have been the cause of much confusion and the consequent creation of synonyms where original descriptions or later amplifications based on single insects or small series have been followed. The descriptions of the male terminalia are based on cleared balsam mounts in order to conform with the general practice. This procedure necessarily forces all the parts into a single plane and often changes the natural form of the organs so that they would be unrecognizable to one who has studied these parts in uncleared mounts. The arrangement and form of parts in microscopic mounts, however, generally remain constant for the species so that, from a comparative standpoint, little confusion arises through this type of preparation if the method is noted.

The ecological data have been gathered over a period of nine years, three summers having been devoted to this work exclusively. One of these was spent at Chico, California, in coöperation with the United States Public Health Service party investigating the relationship of rice culture to mosquito and malaria production. The other two summers were spent at the University laboratory at Vina, California, where the writer carried on intensive studies in culicid oviposition and breeding waters. During the writer's army experience, part of which was as Assistant Sanitary Inspector of the Port of Embarkation, Newport News, Virginia, the opportunity was accepted to carry on some ecological work which has been incorporated in this paper. Aside from this one instance, all the work included has been carried on in California.

The difficulties of the mechanics of mosquito control have been overemphasized by some of those professionally engaged in this work. Actual antimosquito operations are no more difficult than corresponding agricultural drainage projects except that they require more attention to details. The real science of mosquito control, and the efficient application of control measures, rest upon an accurate knowledge of the taxonomy of the group and a thorough acquaintance with the ecology of the species involved.

ACKNOWLEDGMENTS

It is a sincere pleasure to express gratitude to the friends who have made these studies possible and I regret that many of them must, of necessity, be referred to by groups.

Professor W. B. Herms, to whose unflagging zeal California owes much of her reduction in malaria incidence, has been for nine years a perpetual source of encouragement and advice. Dr. H. T. Fernald and Dr. C. E. Marshall of the Massachusetts Agricultural College have

read and criticized the manuscript in an extremely helpful manner, and Dr. G. C. Crampton and Dr. C. P. Alexander of the same institution have offered many valuable suggestions on difficult points of morphology and taxonomy. The editors of this series, Professors C. W. Woodworth and E. C. Van Dyke, have given freely of their time and knowledge, and I am indebted to Mr. W. C. Matthews for the halftone reproduction.

Dr. Harrison G. Dyar of the United States National Museum and Mr. F. W. Edwards of the British Museum have aided very materially with valuable specimens and critical comments, and I have to thank Dr. Dyar further for his kind consent to write the description of *Culex badgeri* Dyar and for his criticism and correction of the various keys. Thanks are also due to the superintendents of the mosquito-abatement districts of California for sending in abundant collections of mosquitoes and giving freely of their field observations, and to the California State Board of Health for the opportunity to canvass the mosquito population of the entire State made possible through the liberal *carte blanche* granted to its Consulting Entomologists. I also extend hearty thanks to the students who worked with me through several happy summers enthusiastically attempting to unravel a few of the intricacies of mosquito life.

HISTORICAL

Linné, in the tenth edition of the Systema Naturae, catalogued six species of mosquitoes under the one genus *Culex*. Two of the six remain as mosquitoes, *Culex pipiens* L., the cosmopolitan house mosquito, and *Anopheles bifurcatus* (L.), the others falling among the Simuliidae, Chironomidae, and Scatophagidae. Meigen, in 1818, erected the genus *Anopheles*, with *Anopheles bifurcatus* (L.) as the type, basing the separation on the presence of long palpi in both sexes of the new genus. In the same work he erected the genus *Aëdes* on the basis of short palpi in both sexes. In 1827, Robineau-Desvoidy, in the first monograph on the Culicidae, recognized the existing genera and, from Fabricius' contributions to the old genus *Culex*, established the genera *Megarhinus, Psorophora,* and *Sabethes.* In 1881, Lynch-Arribalzaga, on the basis of the armature of the tarsal claws, added five genera, *Ochlerotatus, Taeniorhyncus, Janthinosoma, Heteronycha,* and *Uranotaenia.* Of these *Uranotaenia* and *Taeniorhyncus* persist as valid genera, while *Janthinosoma* became a subgenus of *Psorophora,* and the remainder are submerged in *Aëdes.*

In 1901, following the discoveries in connection with malaria, which had given a great impetus to the study of mosquitoes, Theobald published the first volume of his "Monograph of the Culicidae of the World." In this work (five volumes in all, the last appearing in 1910) the author raised those existing genera which were based on the characters of the palpi and proboscis to subfamily rank and, using scale variations as generic characters, succeeded in outlining nearly 150 genera.

Theobald's classification, because it was the only modern treatise on the subject, was widely adopted, but the difficulty encountered in attempting to use genera based on characters that are not entirely safe for specific differentiation soon become manifest. Felt, in 1904, using the venation, male genitalia, and larval characters, proposed a satisfactory classification of American culicids. Dyar and Knab in 1906 produced a classification based entirely on larval characters, not as a practical guide but to "throw light on the phylogeny of the group and indicate the more reliable distinctions." The same authors in 1907 published a classification of adults, avoiding the use of secondary sexual characteristics. This was adopted by Williston in the third edition of his Manual of North American Diptera. In the fall of 1915, there appeared the third volume of Howard, Dyar, and Knab, The Mosquitoes of North and Central America and the West Indies. This publication, together with the fourth volume (1917), gave the American workers a comprehensive and exceedingly valuable compendium of information, which from its very nature was destined to be a landmark in the study of American mosquitoes. Considerable revisional work has since been done by Dyar and Edwards, the former publishing largely in the files of *Insecutor Inscitiae Menstruus* and the latter in the *Bulletin of Entomological Research.*

Edwards considers the family Culicidae to include the dixids, chaoborids, and culicids, each of which is given subfamily rank, and the last in turn is divided into the tribes Anophelini and Culicini. The writer agrees thoroughly with the tribal division but would elevate the groups to subfamily status. This would necessitate the exclusion of the Dixinae and the Chaoborinae from the family Culicidae. There is no doubt that both groups are closely connected phylogenetically with the true mosquitoes, but they form such compact groups within themselves and differ so radically in various features from the mosquitoes that it seems more logical to maintain them as family entities. The retention of the tribe Sabethini on a par with Culicini, as suggested by Dyar, cannot be supported, as the so-called

Sabethini merge with Culicini on every character that has been proposed. Neveu-Lemaire (1923), who had evidently overlooked the work of Edwards in which the latter showed conclusively that the Sabethini could not be separated from the Culicini, not only suggests retaining that tribe as a subfamily but adds two more, Megarhininae and Uranotaeniinae. This separation from the other subfamilies is based on the shortness of cell R_2, which is shared by both "subfamilies." They are further separated by the straight proboscis of *Uranotaenia* and the curved one of *Megarhinus.* It appears to the writer that in this case specific characters have been given too much prominence!

For the purposes of this paper, the family Culicidae will be interpreted as containing two subfamilies, the Anophelinae and the Culicinae.

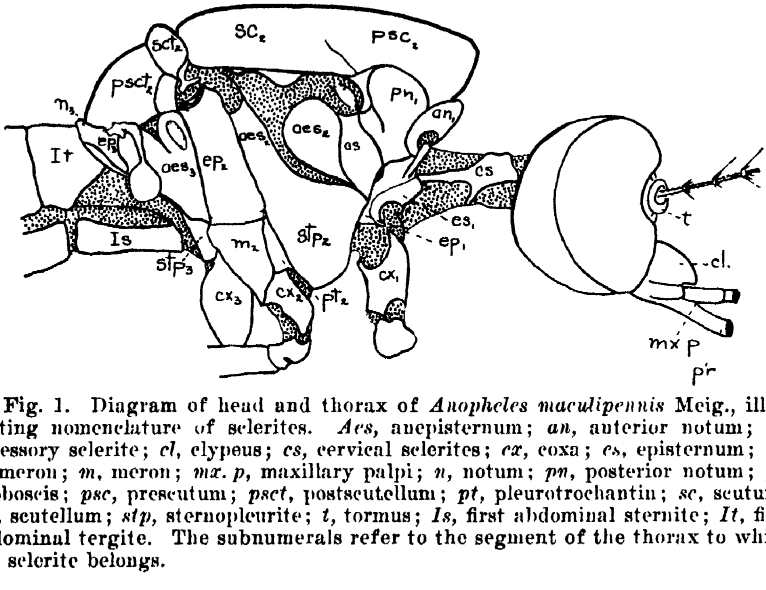

Fig. 1. Diagram of head and thorax of *Anopheles maculipennis* Meig., illustrating nomenclature of sclerites. *Aes,* anepisternum; *an,* anterior notum; *as,* accessory sclerite; *cl,* clypeus; *cs,* cervical sclerites; *cx,* coxa; *es,* episternum; *ep,* epimeron; *m,* meron; *mx. p,* maxillary palpi; *n,* notum; *pn,* posterior notum; *pr,* proboscis; *psc,* prescutum; *psct,* postscutellum; *pt,* pleurotrochantin; *sc,* scutum; *sct,* scutellum; *stp,* sternopleurite; *t,* tormus; *Is,* first abdominal sternite; *It,* first abdominal tergite. The subnumerals refer to the segment of the thorax to which the sclerite belongs.

ANATOMICAL TERMS

It is not the object of this paper to offer a detailed study of the external anatomy of the mosquito, but to present merely definitions of the parts mentioned in the taxonomic portion of the paper, which, in addition to the figures of the adults and larvae, should facilitate the location and identification of these parts.

ADULT. *Head* (fig. 1). The *proboscis* is the beak containing the mouth parts. The visible portion is composed largely of the labium, which enfolds the other mouth parts. At its distal end are two fleshy lips, the *labella,* which represent the labial palpi.

The *maxillary palpi, generally* spoken of as merely the *palpi*, lie on either side of the proboscis. They are segmented and fleshy and may be as short as one-fifth the length of the proboscis or may be decidedly longer than that organ. Projecting from beneath the compound eyes and covering the base of the proboscis is the *clypeus.*

The *antennae* have their bases in the areas formed by the emarginations of the compound eyes. Their basal segments support large, subspherical, apically

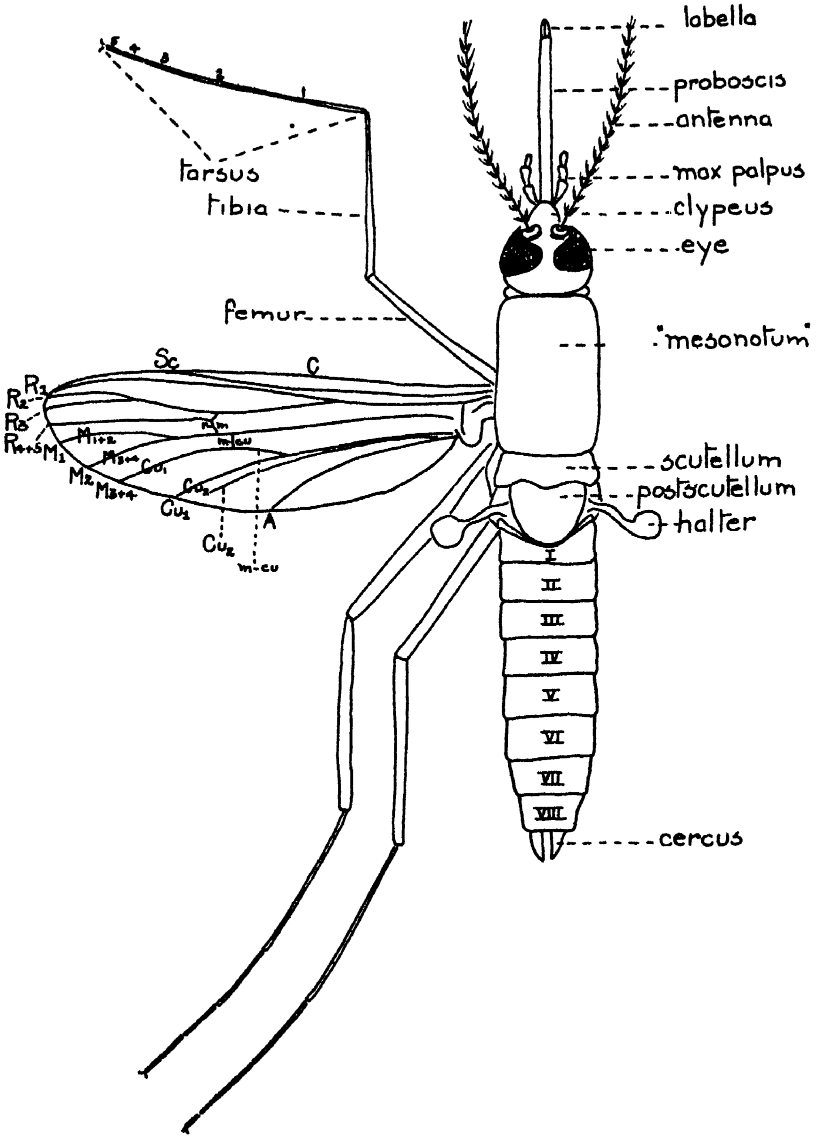

Fig. 2. Diagram of adult female mosquito. The venation of the wing is labeled outside the margin according to the interpretation of Tillyard, the symbols within the margin referring to the interpretation of Comstock.

excavated segments, the *tori*. The antennae proper arise from the excavation of the tori and consist of a series of short, generally setose segments. The first of these is spoken of as the *"second" segment* although in reality it is the third, the torus forming the second and the hidden basal segment the first.

The *occiput* is rather loosely defined in mosquitoes to include that portion of the head capsule that lies behind the eyes, the *vertex* comprising the median portion on the top of the head. The *nape* is borrowed from human morphology and is self-explanatory.

Thorax (figs. 1, 2, 3). The designation of the pleural sclerites is most easily followed by referring to figure 1. Some confusion may result if one attempts to follow with this figure the work of other authors, as the writer has only recently (1924) pointed out that the sclerite labeled *"pn"* (in figure 1) is of pronotal origin and not the proepimeron, as assumed to date by all the other culicidologists.

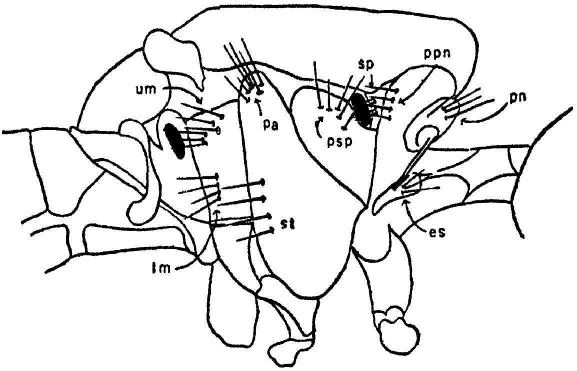

Fig. 3. Composite diagram of the thorax of a mosquito, illustrating the nomenclature of the chaetotaxy. *Es*, episternals; *lm*, lower mesepimerals; *pa*, prealars; *pn*, anterior pronotals; *ppn*, posterior pronotals or proepimerals; *psp*, postspiraculars; *sp*, spiraculars; *st*, sternopleurals; *um*, upper mesepimerals.

The sections of the leg used for taxonomic purposes are, beginning at the proximal end, *coxa*, *femur*, *tibia*, and the five segmented *tarsus*, the sections of which, beginning at the proximal end, are designated as the *first* to *fifth* or *last tarsal segments*. At the end of the last tarsal segment is a pair of *tarsal claws* or *ungues* or sometimes a single claw. These tarsal claws are often toothed and, as an easy means of describing this condition, a claw formula is used. This formula consists of three sets of numerals separated by hyphens. The first, second, and third sets refer respectively to the claws of a single fore, mid-, or hind leg. Each set, in turn, is divided by a period into two numerals which refer to the number of teeth borne by each claw. In the case of the fore-, mid-, or hind legs having but a single claw, its set in the formula is represented by a single numeral following the period. Simple, untoothed claws are represented by "0." For example: if the claws of the foreleg are simple and untoothed they are represented in the formula by -0.0-; the claws of the mid-leg have one claw simple and one with two teeth, -0.2-; the claws of the hind leg may have one tooth on each claw, -1.1-. The complete formula would be -0.0-0.2-1.1-.

The *wings* are borne on the mesothorax. The figure (fig. 2) is labeled according to the systems of nomenclature of Comstock and of Tillyard, which may be correlated with the usual culicid terminology by using the following table.

	Tillyard	*Comstock*
Costal	Costal (C)	Costal
Subcostal	Subcostal (Sc)	Subcostal
1st Longitudinal	Radius (R_1)	R_1
2d Longitudinal	R_2, R_3	R_2, R_3
3d Longitudinal	R_{4+5}	R_{4+5}
4th Longitudinal	Media (M_1, M_2)	M_{1+2}, M_{3+4}
5th Longitudinal	M_{3+4}, Cubitus (Cu_1)	Cu_1, Cu_2
———	Cu_2	———
6th Longitudinal	Anal (A)	A

The *costal margin* is the anterior border of the outspread wing and the *fringe* is composed of the outstanding scales along the posterior border when the wing is in the same position.

The *halteres* are capitate projections of the metathorax, homologous with the wings.

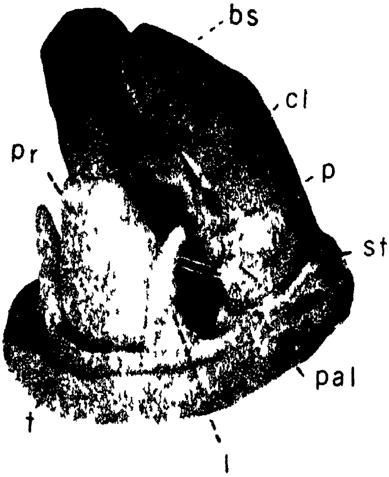

Fig. 4. Photograph of model of terminalia of *Anopheles maculipennis* Meig. The dististyles which normally articulate at the ends of basistyles are omitted. *Bs*, basistyle; *cl*, claspette lobes of the interbasal fold; *l*, lobe of the ninth tergite; *p*, base of phallosome; *pal*, parabasal lobe with spines; *pr*, proctiger.

Mesonotum, as used in the text, refers only to the anterior portion of the true mesonotum, being the notal section lying between the prothoracic lobes and the scutellum. The true mesonotum consists of this anterior portion followed posteriorly by the *scutellum*, a narrow elevated band, and a third portion, the *postscutellum* which takes the form of a sloping convex plate. This is the section incorrectly termed "metanotum" by many writers and is the "postnotum" of other authors.

Abdomen. The abdomen consists of eight visible segments and the terminalia, which are composed of modifications of the ninth, tenth, and eleventh segments.

The *female terminalia* consist of the modifications surrounding the genital and anal orifice. The genital orifice, into which empty the common oviduct, the spermatheeal duct, and the caecum, opens to the exterior ventrally just beyond the apex of the eighth segment. Directly behind the genital opening a flat, chitinous plate called the *ventral piece* or *postgenital plate* extends caudad under the *proctiger* or anal protuberance, which is sheltered by two dorsolateral projections known as *cerci.*

The *male terminalia* (fig. 4) are composed of the abdominal segments caudad of the seventh together with their appendages. Shortly after emergence from the pupa case this portion of the abdomen rotates through an angle of 180°, thus bringing the sternites into a dorsal position, the dorsal portions becoming ventral.

The eighth segment is of interest because it enters into this rotation and also because, in the genus *Theobaldia* and in others, the tergites of some species bear rows or clumps of stout bristles of taxonomic importance.

The ninth is preëminently the genital segment. Its tergite bears setiferous lobes and its appendages (uropods) have become modified into the external genital armature. The exopodites of these limbs form the clasping organs known as *gonostyles,* which are divided into a basal portion, the *basistyle,* and a distal segment, the *dististyle,* which in turn bears a terminal or subterminal spine known as the *appendage of the dististyle.* The endopodites of these limbs form the penis valves or *aedoeagus.* The actual guard structure of the penis is, however, a combination of the true aedoeagus with tissue scooped out of the inner surfaces of the basistyles, and for this reason the amplified structure is known as the *phallosome* or mesosome. On species having the phallosome sunken into the floor of the complex, the walls of the well thus formed are seen in balsam mounts as flaring, triangular plates, to which the name *paramere* has been applied.

Forming an amphitheater around the genital opening and acting as a cushion between that structure and the gonostyles is a fold of tissue known as the *interbasal fold.* The projections and manifestations of this fold enter prominently into the taxonomy. In the generalized mosquitoes its projections take the form of cones lying at the base of the gonostyle. In *Aedes* one portion fuses with the gonostyle forming the *basal lobe,* while a more ventral portion becomes erected into strap or lance like projections termed *claspettes.* In *Culex* the tip of the projection has become fused with the basistyle near the apex of that organ and is known as the *subapical lobe.* In *Anopheles* setiferous lobes are present ventrally and lobe-like continuations are fused dorsally to basistyles. These are known respectively as the *claspette lobes* and the *parabasal lobes.*

The anal portion of the terminalia is theoretically composed of the tenth and eleventh segments and the telson. It takes the form of a membranous mound, encircled by the ninth segment, and lying dorsad of the genital opening originally, before the rotation places it in its secondarily ventral position. The whole structure is known as the *proctiger.* It is supported ventrally by two chitinous strips known as tenth sternites or *paraprocts.* At their bases each strip has two projections in some genera, one surrounding the base of the proctiger known as the *lateral arm of the paraproct* and one extending ventrally around the phallosome, which is known as the *ventral arm of the paraproct.* There is sometimes present on the dorsal face of the proctiger a pair of chitinous plates known as *epiprocts.*

LARVA (figs. 5 and 6). *Head.* The most useful taxonomic structures of the head are the clusters of hairs projecting from its dorsal surface. In *Anopheles,* the *outer* and *inner anterior clypeal hairs* are extremely important. These are composed of a row of four hairs extending forward from the most anterior portion of the head visible in a dorsal view. The outer pair are the *outer anterior clypeal*

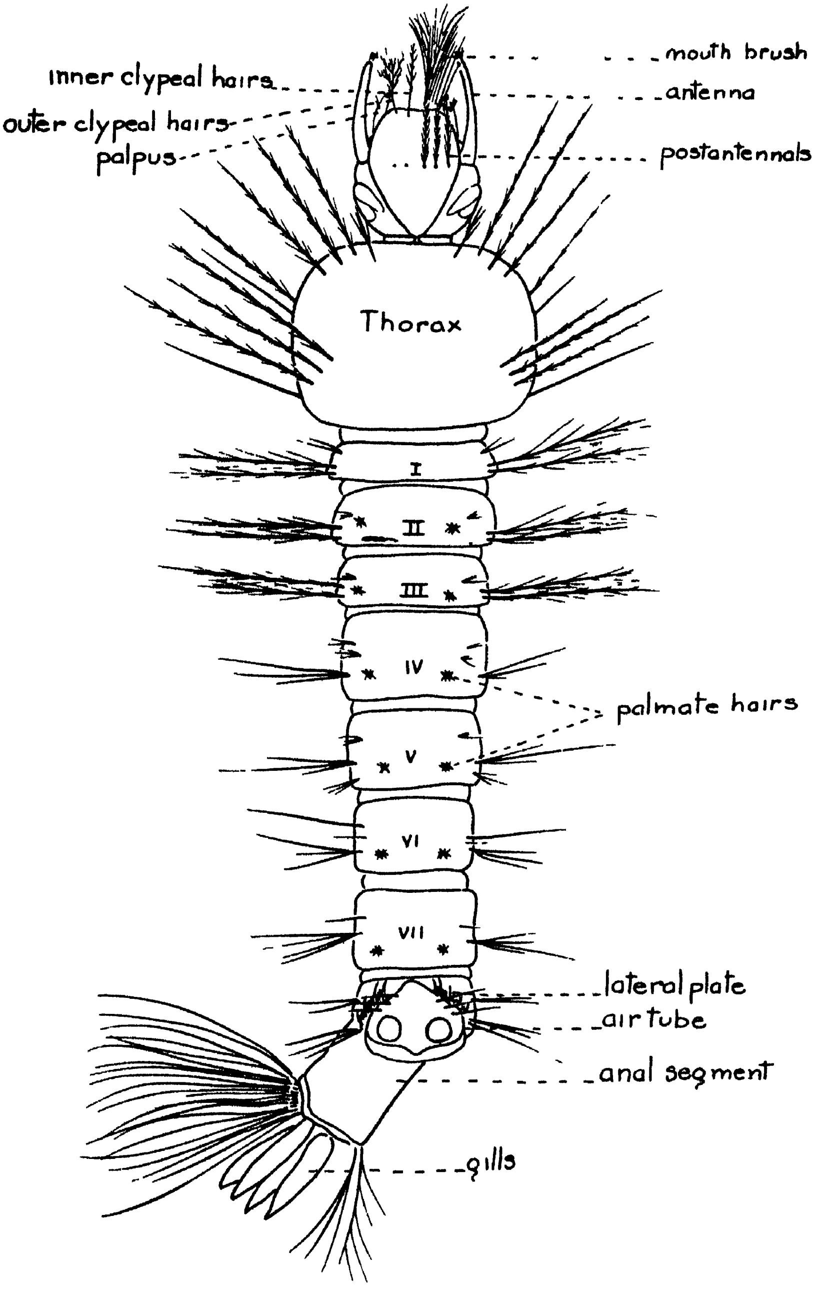

Fig. 5. Diagram of an anopheline larva.

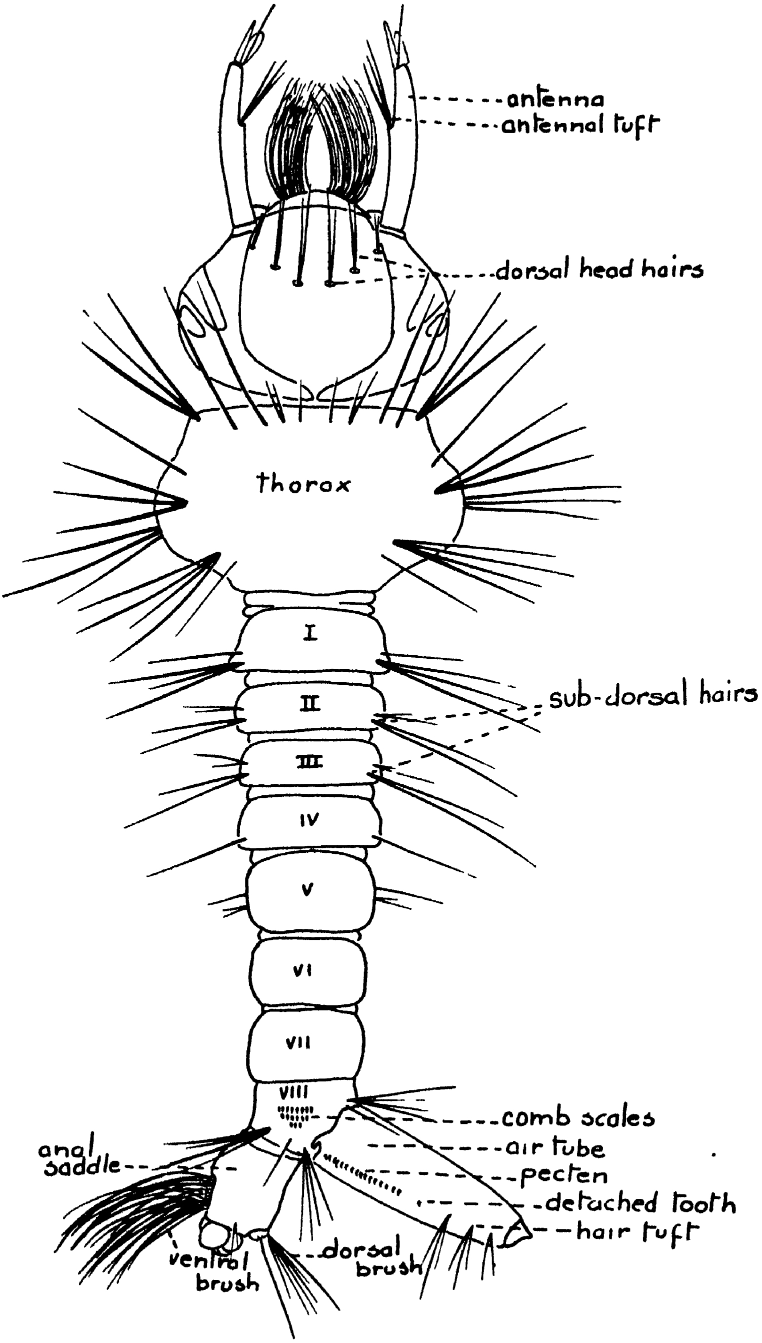

Fig. 6. Diagram of a culicine larva.

hairs and the inner pair are the *inner anterior clypeal hairs.* These hairs are apparently absent in the other genera represented in California. Just caudad of a line joining the insertion of the antennae there is a row of hairs made up of three pairs. These are called the *postantennal hairs.* They are divided into the *inner postantennal hairs,* the pair lying with one hair on each side of the median line, the *mid-postantennal hairs,* the next pair removed from the center, and the *outer postantennal hairs,* the pair lying at the bases of the antennae. In *Anopheles,* all six hairs lie in a straight line across the head but in the other Californian genera they form a semicircle, the inner postantennal pair sometimes lying directly behind the mid-postantennals. In the text, the mid-postantennal hairs are referred to as the *lower dorsal head hairs* and the inner postantennal pair is termed the *upper dorsal head hairs.*

The only portion of the complicated labium visible in the undissected larva is a triangular, heavily chitinized, laminate structure with serrate edges, which we have termed in the text the *mental plate.*

The *antennae* are the most prominent projections of the larval head, arising laterally about one-third of the distance back from the anterior border. They bear an *apical armature* of varying constituents at their distal end and generally a clump of hairs, the *antennal tuft,* about midway of the appendage. This tuft is sometimes inserted in a depression, which is then termed the *antennal notch.*

Thorax and abdomen. The thorax is richly ornamented with spines and hairs, particularly along the anterior and lateral margins. Various attempts have been made to capitalize the arrangement of these for taxonomic purposes but their plasticity makes such a procedure of doubtful use.

The large *subdorsal hairs* of the abdominal segments, particularly of the third and fourth segments, offer a more stable foundation for taxonomic work than the thoracic hairs.

The daisy-like rosette hairs known as *palmate hairs* are present in pairs on the dorsal aspect of the abdomen in *Anopheles.* These usually occur on the third to seventh or second to seventh segments and aid the larvae in maintaining their horizontal position at the surface of the water.

The eighth abdominal segment bears dorsally the projection of the air tube which Christophers (1922) has homologized with the ninth abdominal segment. On the lateral aspects of this segment are located groups of scales known as the *comb scales of the eighth abdominal segment.* In the main, these scales are slipper-shaped, their distal ends bearing *thorns,* which are of taxonomic value. The *air tube* is sessile in *Anopheles* and guarded laterally by two *lateral plates of the eighth abdominal segment.* In the other genera, the tube is more or less elongate and ornamented along each side basally by a row of specialized spines, the *pecten.* Each tooth of the pecten generally bears projections or hooks at its base, which we have called *denticules.* Along each side of the air tube are found branching hairs, which are termed the *hair tufts* of the air tube. The anal or tenth abdominal segment (according to Christophers) is covered dorsally by a plate of chitin, which sometimes completely surrounds the segment. This plate is known as the *anal saddle.* Four projections from the dorsal side of anal segment caudad of the anal saddle, a pair of *dorsal hairs* and a pair of branched hairs, make up the *dorsal brush.* The *ventral brush* is a row of branched hairs arising from a plate located ventrally and posteriorly on the anal segment. Projecting from the end of the anal segment and surrounding the anus are four *gills*—fleshy non-chitinized structures well supplied with tracheae.

For the differentiation of sex in the adults of all Californian species, it is only necessary to note that the antennae of the males are extremely plumose, those of the females only sparsely haired.

KEY TO GENERA OF CALIFORNIA MOSQUITOES

Adults

1. Wing membrane without mitrotrichia; cell R_2 shorter than its petiole .... **Uranotaenia** Lynch-Arribalzaga.
Wing membrane with microtrichia; cell R_2 longer than its petiole 2
2. Scutellum rounded, not trilobed .... **Anopheles** Meigen.
Scutellum trilobed 3
3. Lower side of base of first vein distinctly pilose; prespiracular bristles present .... **Theobaldia** N.-L.
Without pilosity on lower side of first vein; prespiracular bristles absent 4
4. Abdomen of female blunt; genitalia of male short and down curved; pulvilli present; eyes nearly touching above antennae; terminal joints of female palpus normally elongate; postspiracular bristles absent .... **Culex** L.
Abdomen of female pointed; genitalia of male outstanding, straight; pulvilli absent; eyes distinctly separated above antennae; terminal joints of female palpus globular; postspiracular bristles present .... **Aëdes** Meigen.

Larvae

1. Air tube rudimentary .... **Anopheles** Meigen.
Air tube elongate 2
2. Air tube with single tuft on each side 3
Air tube with several tufts on each side .... **Culex** L.
3. Head elongate, elliptical .... **Uranotaenia** Lynch-Arribalzaga
Head not elliptical 4
4. Pecten teeth followed by row of long hairs .... **Theobaldia** N.-L.
Pecten teeth not followed by row of hairs .... **Aëdes** Meigen.

Male Terminalia

1. Phallosome rodlike .... **Anopheles** Meigen.
Phallosome not rodlike 2
2. Paraprocts absent, epiprocts prominent .... **Uranotaenia** Lynch-Arribalzaga.
Paraprocts present, epiprocts not prominent 3
3. Paraprocts crowned with a profuse crest or pectinate limb .... **Culex** L.
Paraprocts without such ornamentation 4
4. Basistyles with small basal lacunae; interbasal projections always in the form of a basal cone .... **Theobaldia** N.-L.
Basistyles with elongate lacunae generally reaching their full length; interbasal projection never in the form of a basal cone (Californian species) .... **Aëdes** Meigen.

SUBFAMILY CULICINAE

Genus **Uranotaenia** Lynch-Arribalzaga[1]

Uranotaenia Lynch-Arribalzaga, Rev. Mus. de la Plata, vol. 1, p. 375, 1891.
Anisochelomyia Theobald, Entom., vol. 38, p. 52, 1905.
Pseuduranotaenia Theobald, Jour. Econ. Biol., vol. 1, p. 33, 1905.
Pseudoficalbia Theobald, Trans. Linn. Soc. London, vol. 15, p. 89, 1912.

A small, tropical genus of extreme interest from a phylogenetic standpoint. Neveu-Lemaire (1923) is the most recent of a long series of authors to propose its elevation to the status of a subfamily on basis of small size of cell R_2, a detail that would hardly be considered of specific value in most families of insects. Eggs deposited in rafts as in *Culex*. Larvae resembling those of *Anopheles* in shape and comparative size of head and thorax. Larvae of some species said to rest beneath surface in a horizontal plane, which adds to their confusion with *Anopheles*. Air tube long and slender. Pupae minute. Adults distinguishable from all other mosquitoes except *Megarhinus* by relative length of cell R_2 in comparison with its petiole. In these two genera, length of cell less than length of its petiole, proportions varying with the species. *Megarhinus* separated from *Uranotaenia* by its curved, rigid proboscis. Both sexes have extremely short palpi.

Genital appendages of generalized type similar to that of *Theobaldia* and of *Megarhinus*. Process of interbasal fold a primitive basal cone bearing apical spines. Phallosome an upright, semilunar process of two plates bearing ventral hooks. Anal appendages vary from generalized type by absence of paraprocts and by extreme development of epiprocts, which cover and protrude beyond dorsal surface of proctiger.

Genus tropicopolitan. Four species reach the United States: *Uranotaenia lowii* Theob., in Florida and Louisiana, *Uranotaenia socialis* Theob., in Louisiana, *Uranotaenia sapphirinus* (O.S.) throughout the eastern states, and *Uranotaenia anhydor* Dyar in southern California.

Howard, Dyar, and Knab (1912–1917) have suggested an affinity between *Uranotaenia* and *Anopheles* through the genus *Bironella*. Mr. F. W. Edwards of the British Museum, who has seen Theobald's type of *Bironella*, has assured the writer in correspondence that it is typically anopheline. There is nothing about the male terminalia of *Uranotaenia* to suggest a close affinity with *Anopheles*.

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[1] Following the advice of Dr. C. W. Stiles, I have avoided the literal transcription of the dipthong "æ" in generic and specific names in order to avoid confusion with the dipthong "œ."

Uranotaenia anhydor Dyar

Uranotaenia anhydor Dyar, Proc. U. S. N. M., vol. 32, p. 128, 1907.
Uranotaenia anhydor Howard, Dyar, Knab, Mos. N. and Central Am. and West Indies, vol. 4, p. 1041, 1917.

FEMALE. *Head.* Integument dark; occiput clothed with flat scales, black and dark brown; ocular margins shiny white with heavy dark bristles; nape with many black, upright forked scales. Proboscis black, apically dilated. Palpi shorter than clypeus, black. Tori pale brown, dark stain on inner sides; antennae black.

Thorax. Mesonotum brown; vestiture of thin, concolorous scales with a few metallic, violet blue scales above wing insertions and before antescutellar space; three longitudinal rows of stout black bristles. Scutellum trilobed, brown, with many black bristles and a few brown scales. Pleurae pale brown with some violet scales. Coxae, tibiae, and tarsi entirely black scaled, the femora with some sordid white scales beneath. Claws simple -0.0-0.0-0.0. Wings black scaled, both fork cells slightly shorter than their petioles. Length of wing 2.6 mm.

Abdomen. Dorsal vestiture of black scales with basal, lateral, segmental, white spots. Ventral vestiture of sordid white scales. Length of body 3 mm.

MALE.[2] "Proboscis straight, moderately long, distinctly enlarged toward apex. Palpi very short, slightly extending the clypeus. Antennae plumose, rather long, the last two joints long and slender, rugose, brown, with long pile, the others shorter, subcylindrical, with dark rings at the insertions of the hair-whorls. Coloration similar to that of the female. Abdomen subcylindrical, rather more slender than in the female, with many coarse bristles on the genitalia; brown, tips and sides of segments black, no white spots. Wings rather narrower than in the female, the stems of the fork-cells longer, the second marginal cell being less than half the length of its petiole; vestiture sparser. Claw formula, -0.0-0.0-0.0; one claw of the hind legs very large, the other of usual size." Length of body about 3 mm.; length of wing 2.3 mm.

LARVA.[3] "Head elongate, elliptical, bulging at eyes; front prominent, the clypeus large, with a median emargination and a short stout spine on either side of it; antennae rather small, subcylindrical, slightly thickened basally, scarcely spinous, with a single hair near base; dorsal head hairs not thickened, the upper pair a tuft of three fine hairs, the lower pair a single coarse long hair; lesser lower tufts in fours, short; ante-antennal tufts multiple, well developed. Lateral abdominal hairs long and coarse on first and second segments, fine, multiple and short on the succeeding ones; subdorsal series in tufts. Air tube about five times as long as wide, scarcely tapered; pecten of fifteen evenly spaced spines not reaching middle of tube, followed at middle by a large multiple hair-tuft. Lateral plate of eighth segment

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[2] The description of the male and larva is that of Howard, Dyar, and Knab, 1917, vol. 4, pp. 926 and 1041, as these forms are unknown to the writer.

[3] Howard, Dyar, and Knab, *loc. cit.*

with an angular projection below and comb of nine sharp teeth on its posterior border, those near the center longer than the others. Anal segment longer than wide, ringed by the chitinous plate, which is spinose along its posterior margin; dorsal tufts of three long hairs on each side; ventral brush long but sparse, confined to the barred area; anal gills four, equal, very slender, not as long as anal segment.

"A sigle larva was obtained in a swamp full of reeds, associated with *Anopheles occidentalis* [*maculipennis*], *Anopheles pseudopunctipennis Culex tarsalis,* and *Culex erythrothorax.*"

This species was named *anhydor* by Dyar on account of the fact that, when he attempted to collect more specimens, he found that the pool which had yielded the single type larva had dried. The species is extremely rare. Dyar has bred the adults from larvae collected in a pond at Old Town, San Diego (May, 1916). The original name was proposed for a single larva taken by Dyar and Caudell (Sweetwater Junction, San Diego Co., June, 1906) which died before pupating. The writer was fortunate in seeing a single female taken at Camp Kearney (near San Diego) in May, 1918. This specimen was taken in a large packing box placed near a fresh-water creek for the purpose of affording a collection point in the otherwise barren terrain. It was in perfect condition and gave every indication of having emerged but a short time before capture.

KEY TO CALIFORNIAN SPECIES OF GENUS THEOBALDIA

Adults

1. First two tarsal segments white ringed 2
First two tarsal segments not white ringed 3

2. Cross-veins scaled, wing membrane fuscous at spots of heavy scaling, first four tarsal segments of fore- and midlegs ringed .... **maccrackenae** (D. & K.)
Cross-veins nude, wing membrane not stained, fore- and midtarsi with first two segments ringed .... **incidens** (Thom.)

3. Cross-veins scaled, wings unspotted .... **inornata** (Will.)
Cross-veins nude, with indistinct spots at vein forkings .... **impatiens** (Walk.)

Larvae

1. With the two anterior tufts of the ventral brush puncturing the chitinization of the anal segment 2
With these tufts inserted in a cleft in the chitinization .... **maccrackenae** (D. & K.)

2. Lower head tuft with three long hairs, or if more, with two or three hairs stouter and longer, upper multiple 3
Both head tufts multiple, alike .... **impatiens** (Walk.)

3. Basal pecten teeth of air tube slender with one or two appressed denticules .... **incidens** (Thom.)
Basal pecten teeth of air tube with three or four stout outstanding denticules .... **inornata** (Will.)

Male Terminalia

1. Eighth tergite with row of stout spines 2
   Eighth tergite without row of stout spines 3
2. Phallosome squarely truncate at tip; spines of eighth tergite consolidated in a median clum- .... **incidens** (Thom.)
   Phallosome conical; spines of eighth tergite in a row ....**impatiens** (Walk.)
3. Phallosome tipped with furcate chitinizations.................. **inornata** (Will.)
   Phallosome not so ornamented ....**maccrackenae** (D. & K.)

Theobaldia Neveu-Lemaire[4]

Theobaldia Neveu-Lemaire, C. R. Soc. Biol., vol. 54, p. 1331, 1902.
Culiseta Felt, Bull. 79, New York Sta. Mus., p. 391*c*, 1904.
Theobaldinella Blanchard, Les Moust., p. 390, 1905.
Pseudotheobaldia Theobald, Mon. Culic., vol. 4, p. 150, 1907.
Allotheobaldia Brolemann, Ann. Soc. Entom. France, vol. 88, p. 90, 1919.

The genus *Theobaldia* is a small, compact group of Holarctic mosquitoes partaking of many *Aëdes* characters on the one hand and *Culex* characters on the other. The genus is limited to the north temperate zone except for one doubtful African species. But one species is common to both the New and Old World -*T. alaskaensis* Ludlow, which extends from Scotland, across Siberia and Alaska to Alberta. The common European *annulata* is close to *maccrackenae* of California, and the European *glaphyroptera* resembles *impatiens* of Canada and northern United States. The commonest Californian species, *incidens*, has no counterpart in Europe, nor has *inornata*.

The genus *Theobaldia* was founded with *annulata* as a type on the basis of the knoblike terminal joint of the female palpi, but this character applies to the genus *Aëdes* as well. *Culiseta*, applied originally to the spotted wing forms of the group, was amplified to include the other members. There is no one character that separates the genus from all other genera. The tendency of the anterior and posterior cross-veins to lie in one line or nearly so has been used extensively and holds for females among the Californian species but is not applicable to the males nor, occasionally to the females of *Theobaldia inornata*. The spotting of the wings leads, among laymen, to confusion with *Anopheles*, but this resemblance is applicable to only two of the four Californian species—*incidens* and *maccrackenae*. Edwards (1921) has pointed out the presence of a row of prespiracular bristles (figs. 3, 7) in *Theobaldia,* which distinguishes the members of the genus from all other California mosquitoes. The other genera in which they occur (*Megarhinus, Psorophora,* and some "sabethine" genera) are absent from California. These bristles are easily detected and are distinct from the pronotal ("proepimeral") bristles, which are also present. They are arranged in a row below the lateral edge of the posterior pronotum, in the triangular area bounded by the prescutum, the posterior pronotum, and the spiracle itself. The postspiracular bristles are absent, as in *Orthopodomyia.*

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[4] European writers prefer the generic name *Theobaldia* Neveu-Lemaire, but American writers have held that *Theobaldius* Nevill preoccupied this name. The proponents of *Theobaldia* are within their rights as there is no ruling to prohibit the use of the same roots with different gender terminations for generic names, these names not being subject to change of gender terminations as are the specific names.

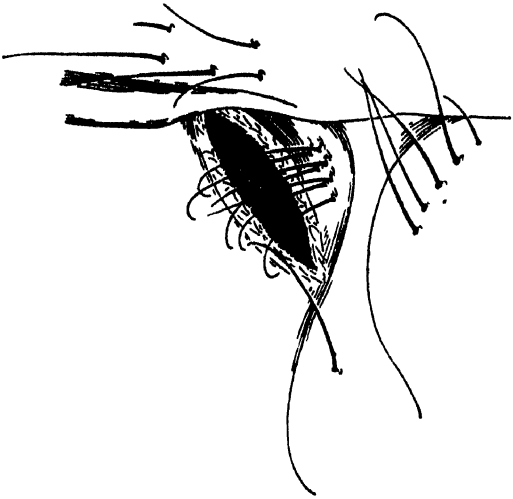

Fig. 7. Anterior thoracic spiracle of *Theobaldia incidens* (Thom.) showing prespiracular bristles.

On the basis of male terminalian characters, the genus is divided into two subgenera in the Nearctic—*Culicella,* in which the phallosome is divided into two flaring lateral plates, and *Theobaldia* (*sens. str.*), in which the phallosome has the lateral plates united. All the Californian species belong to the latter subgenus. Edwards uses a third subgenus, *Allotheobaldia* Brolemann, characterized by the development of the ninth tergite, for the reception of *Theobaldia longiareolata* (Macq.).

The larvae are distinctive in that the pecten is continued apically as a row of long hairs and the air tube is ornamented with one pair of hair tufts situated at or near the base of the pecten and between (ventral) the rows of pecten teeth (in common with *Megarhinus*).

The head hairs are multiple. The whole body, particularly the thorax, has a profusion of long hairs giving the larvae a shaggy appearance which distinguishes them macroscopically.

Theobaldia (Theobaldia) maccrackenae (Dyar and Knab)

Culiseta maccrackenae Dyar and Knab, Proc. Biol. Soc. Wash., vol. 19, p. 133, 1906.

FEMALE. *Head.* Integument dark brown; occiput with pale yellow, narrow curved scales on vertex, ocular margins white, the sides with flat white scales; ocular bristles light brown; nape with erect, forked, dark scales, those at sides paler. Tori light brown, inner surfaces with white scales; antennae dark brownish black. Palpi one-fifth the length of proboscis, dark brown with a few pale scales, segments white ringed except base of first and apex of last. Proboscis dark brownish black with a few pale scales beneath.

Thorax. Mesonotum dark brown with a median, anterior, broad stripe mahogany red, three stripes of white "bloom" proceeding anteriorly from antescutellar spaces; clothed with dark and light yellow scales and some minute brown ones, the darker yellow scales forming a median stripe, the pale ones around anterior and antero-lateral margins and antescutellar space, the minute brown ones forming background for this ornamentation; several sets of variable bare lines. Scutellum olive brown with many soiled white scales and black bristles. Pleurae pale brown with mottled darker spots, white scales, and pale bristles. Coxae pale with white scales and brownish bristles; femora black and yellow scaled, the hind femora white beneath on basal half, upper surface black with a few yellow scales except for subapical ring of yellow scales followed by black ring; knees very narrowly yellow; tibiae black and yellow scaled with variable lateral yellow lines; tarsi with basal rings of pale yellow scales, progressively narrower toward distal segments, last segments of fore- and mid-tarsi without bands but scaling of entire segment very pale brown scarcely darker than preceding rings. Claws simple, 0.0-0.0-0.0. Wing scales brown with a few white ones in costal area and some pale ones in spots on fringe; cross-veins very nearly in a line and densely scaled on one side; base of second vein, forks of second and fourth, and apices of third and sixth veins so densely scaled as to produce spots, brownish stains on wings at base of the second, forks of second and fourth, and at cross-veins. Halteres with stems greenish white, and knobs black. Length of wing 7.0 mm.

Abdomen. Dorsal vestiture black with moderate basal, segmental, white bands, slightly produced medianly by yellowish scales, and with some pale scales in dark apical portion, first segment white scaled, and eighth almost entirely white scaled. Ventral vestiture of whitish scales with V-shaped black lines, the point basal, although this marking sometimes reduced to subapical, sublateral black spots. Length of body 6.5 mm.

Male. Coloration as in female, abdominal bands wider, vestiture sparser and less distinct. Cross-veins generally in a line. Palpi slightly longer than proboscis, last segment thickened apically, vestiture dark brown, last two segments and the long segment with basal pale rings, long segment with additional white ring at middle. Claws of fore- and mid-tarsi toothed, those of hind tarsi simple, 2.1-2.1-0.0. Length of body 7.0 mm.; length of wing 6.0 mm.

Terminalia. Basistyles one and one-half times as long as their width at base; dististyles normal; a slight subapical prominence bearing setae; basal lobes roundedly conical with three differentiated spines apically. Phallosome cylindrical, truncated, lateral plates contiguous on dorsal, longer side, approaching each other on upper side, apical edges terminating in small revolute points. Parameres small but heavily chitinized, outwardly curved. Paraprocts reaching to apices of basal lobes, their chitinizations curved outwardly, tips furcate. Lobes of ninth tergite moderate with several slender spines.

Little is known concerning the ecology of this species. Dyar (1924 *b*) has recently described the larva from material received from Dr. McCracken of Stanford University. He states that they may be distinguished from *incidens* by the fact that the two tufts that precede the ventral brush of the anal segment do not perforate the chitinous saddle but are set in an incision.

The writer collected numerous specimens of both males and females at Vina, Butte County, California. They were found hovering over a dark woodland pool which contained numerous *Theobaldia* larvae. These were repeatedly collected and attempts made to rear them in the laboratory, but all specmens invariably died before pupation despite the most elaborate attempts to simulate natural conditions. These larvae were morphologically identical with those of *Theobaldia incidens* (Thom.) but their habitus and behavior were somewhat different. The larvae of *incidens* have a tendency to rest suspended from the surface, while these larvae rested prone on the bottom of the pool, seldom seeking the surface. The full-grown specimens were slightly larger than those of *incidens* and had a noticeable silvery sheen caused by the air in their tracheal trunks.

The adults have a swift soaring flight. They are distinguishable from other species of *Theobaldia* by the characters given in the key. When once seen, the characteristic, smoky spots on the wing membrane distinguish them from all other Californian mosquitoes.

They are limited to California, occurring in wooded parts of the central valley and along the northern coastal region.

Theobaldia (Theobaldia) incidens (Thom.)

Culex incidens Thomson, Kongl. Svens. Freg. Eug. Resa., pt. 6, Dipt., p. 443, 1868.

Culex particeps Adams, Kansas Univ. Sci. Bull., ser. 2, vol. 2, p. 26, 1903.

Theobaldia incidens Theob., Mon. Culic., vol. 3, p. 151, 1903.

Culiseta incidens Felt, Bull. 79, New York State Mus., p. 391c, 1904.

FEMALE. *Head.* Integument brown; occiput with vertex clothed with narrow, curved, brown scales anteriorly and straw-colored ones behind, ocular margins white scaled, scales on sides flat and white; all of scaled portion densely covered with a brown and straw-colored, erect, forked scales. Tori brown with patch of white scales on inner surface; antennae dark brown. Palpi short, one-sixth the length of proboscis, black scaled with some yellow ones at bases of segments. Proboscis black scaled with many white ones intermixed, white ones in greatest numbers at base beneath.

Thorax. Mesonotum with dark brown integument; vestiture of dark brown and golden, narrow, curved scales arranged in longitudinal lines suggesting obscure stripes, anterior margin and antescutellar space with some straw-colored scales. Scutellum white scaled with black bristles. Pleurae brown with a pale "bloom" with yellowish white scales and straw-colored bristles. Coxae paler, also with white scales and straw-colored bristles; femora with a dark stripe, black on the fore- and mid-femora and interrupted by yellowish spot; brown and uninterrupted on hind femora, stripe gradually widening from base to apex where it encircles segment; knees white; tibiae brown scaled above, yellowish beneath and at tips; tarsi brownish black, first two segments narrowly ringed with yellow scales at their bases, last three with only faint indications of basal rings. Claws simple 0.0-0.0-0.0. Wing veins black scaled except cross-veins which lack scales; forks of second and fourth veins, upper branch of fifth vein at its base, and outer portion of sixth vein densely scaled, giving aspect of spotted wings; basal and anterior cross-veins nearly or quite in a transverse line. Length of wing 5 to 7 mm. Halteres brownish, the knob darker.

Abdomen. Dorsal vestiture of black scales with broad, basal, segmental bands of yellowish white scales with black ones intermixed, sometimes forming narrow, apical, black bands. Length of body 4.5 to 6.5 mm.

MALE. Coloration similar to female except vestiture much scantier, and ventral, apical, abdominal black bands sometimes present in female are the rule with males. Erect, forked scales on sides of head decidedly black. Palpi slightly longer than proboscis, terminal segment expanded gradually to tip, segments black scaled, the long segment with a broad central white band and many pale scales basally, last two segments white at base. Fore- and mid-tarsi with forked claws, the hind tarsi with claws simple, 2.1-2.1-0.0.

Terminalia (fig. 8). Basistyles stout, about one and one-half times as long as their width at base; dististyles normal with terminal claws;

apical lobes represented by slight prominences bearing two stout spines and a clump of more slender ones. Lobe at base at inner surface of each basistyle bearing two stout, apical setae and on inner surface a series of five setae. Penis cavity with well developed parameres; phallosome a truncated cylinder, formed by the two lateral plates contiguous on dorsal, longer side, and overlapping on ventral side. Lobes of ninth tergite, which are ventral in matured male, bearing clump of very stout, short spines, four to eight in number.

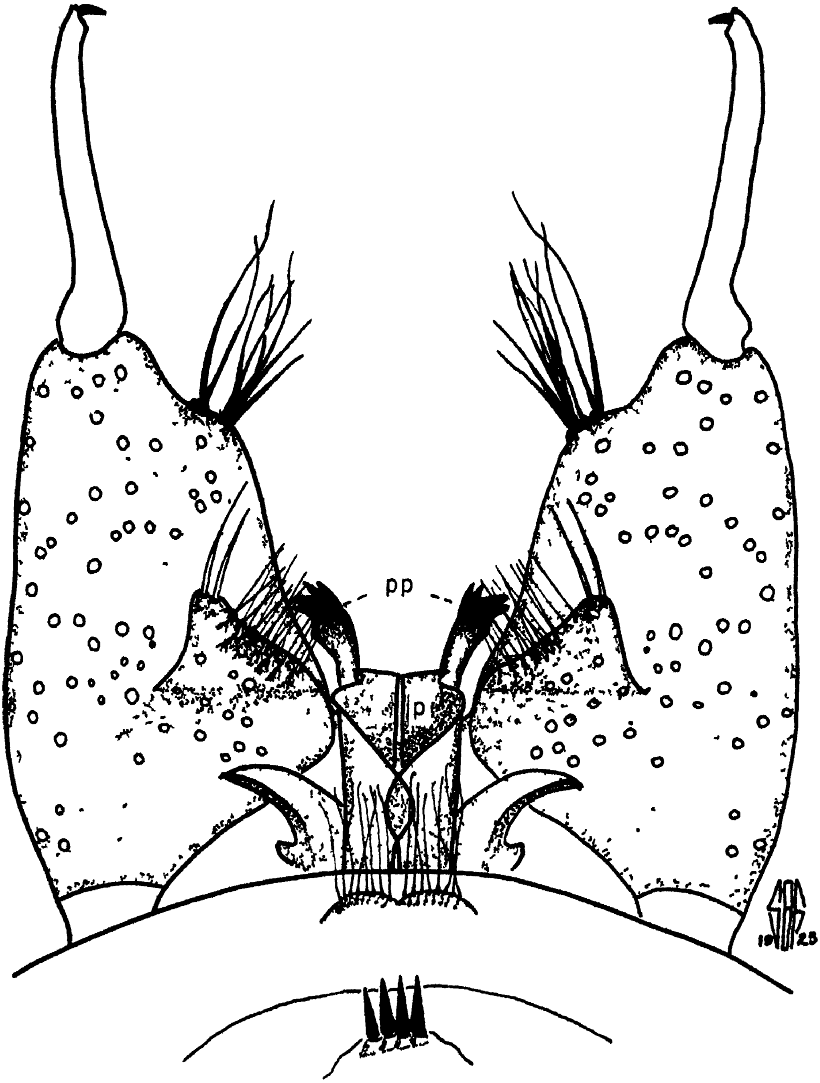

Fig. 8. Male terminalia of *Theobaldia incidens* (Thom.)
P, phallosome; *pp*, paraprocts.

Larva (fig. 9). Air tube stout, about two and one-half times as long as its width at the base, tapered on apical half and very slightly at base; pecten of fourteen small teeth followed by fourteen to eighteen long hairs, basal, true pecten teeth each bearing a long, furcate, basal denticule; a pair of eight-haired tufts within rows of pecten at extreme base of tube. Anal saddle ringing plate, a two-haired tuft present on saddle posteriorly; dorsal brush accompanied by a three-branched hair, one branch extremely long, the other two subequal; ventral brush profuse; two small tufts preceding plate. Anal gills slightly shorter than segment, acutely pointed. Comb scales of eighth abdominal segment numerous in a triangular patch, each scale with rounded basal portion at apical end of which are two stout divergent arms, central portion slender, very slightly expanded apically and with an even fringe of well developed thorns. Mental plate triangular, teeth subequal. Dorsal head hairs multiple, lower pair of five or six hairs but with the three central ones stouter and longer. Antennae slightly and uniformly tapered, sparsely spined, a multiple tuft before the middle, apical end darker than base; apical armature with two subequal moderate setae inserted subapically, and apically a short seta, a conelike rod, and a palpus-like appendage, chitinous at base and membranous apically.

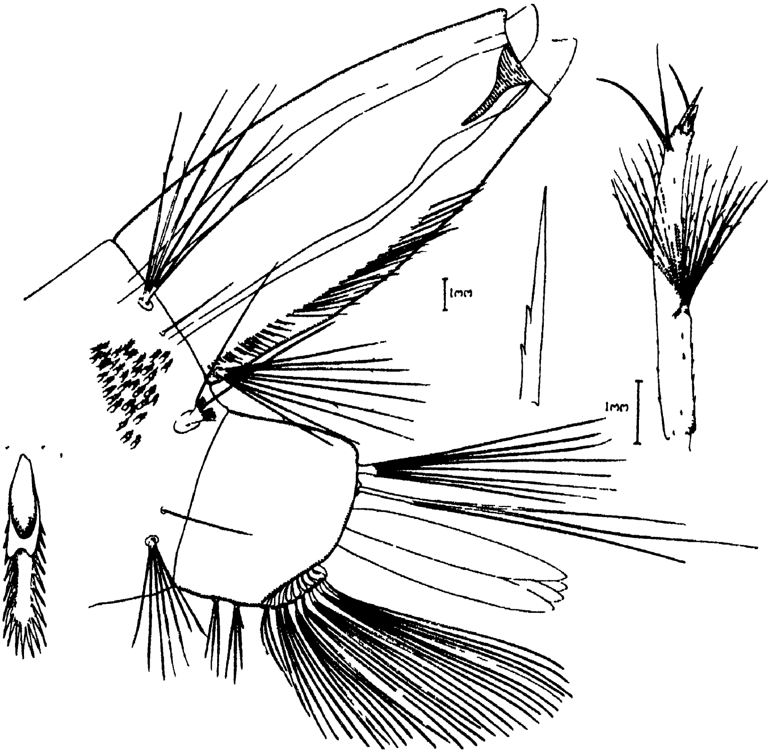

Fig. 9. *Theobaldia incidens* (Thom.). Caudal end of larva with enlarged views of comb scale, pecten tooth, and antenna.

This species is apt to be confused with only one other Californian species of *Theobaldia*—*Theobaldia maccrackenae* D. & K., which also has banded tarsi. It is separated from *maccrackenae* by having the cross-veins devoid of scales and without brown stained areas on the wing membrane at the points of spotting. The larvae differ from those of *inornata* by having a slender basal denticule on the pecten teeth, that is ordinarily divided into two teeth of about equal length that lie closely appressed to the central tooth, often demanding the high dry magnification to distinguish them; whereas the basal denticules of *inornata* are stouter and three or four in number. The comb scales also differ in that *inornata* lacks the basal divergent knobs but has a spatulate anterior portion markedly widened. (Compare figs. 9 and 11.) The male terminalia differs from *inornata* and *maccrackenae* and agrees with *impatiens* by the presence of the specialized spines of the eighth tergite, which are arranged in a clump in *incidens* but

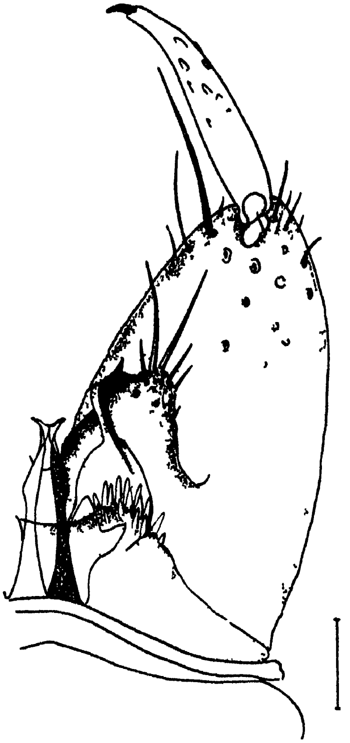

Fig 10

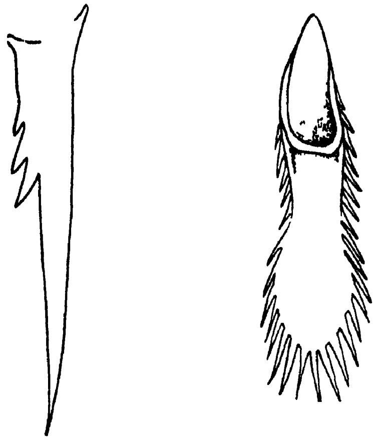

Fig. 11

Fig. 10. *Theobaldia inornata* (Will.). Male terminalia.

Fig. 11. *Theobaldia inornata* (Will.). Pecten tooth and comb scale of larva. The larva is otherwise indistinguishable from *Theobaldia incidens* (Thom.).

occur as a linear row in *impatiens*. The terminalia of *incidens* further differ from *impatiens* by having a cylindrical phallosome (in balsam mounts) and two differentiated spines on the "basal lobe" whereas *impatiens* has a conical phallosome and single differentiated spine on the "basal lobe."

North of the Tehachapi Mountains, this species rivals *Culex tarsalis* Coq. for supremacy of numbers. Normally a domestic species, it is able to breed in all sorts of permanent pools. It breeds continuously throughout the year wherever its breeding places do not ordinarily freeze. The writer has resuscitated larvae of this species which were frozen into sheets of ice. The liberated larvae pupated in the laboratory and emerged as adults without apparent injury. This habit of continuous breeding apparently signifies a relationship with a more southerly fauna. The resistance to lower temperatures suggests a long and gradual acclimatization to a more rigorous climate.

The species ranges through the northwest reaching Alaska and extending south through California to San Diego. In California, it occurs in all parts of the State, but is largely supplanted in the southern third of the State by *Theobaldia inornata* (Will.).

Theobaldia (Theobaldia) inornata (Williston)

Culex inornatus Williston, U. S. Dept. Agr., Div. Ornith. and Mam., N. Am. Fauna, no. 7, p. 253, 1893.

Culex magnipennis Felt, Bull. 79, New York State Mus., p. 278, 1904.

Culiseta magnipennis Felt, Bull. 79, New York State Mus., p. 391c, 1904.

FEMALE. *Head.* Integument black; vestiture of narrow, curved, yellowish brown scales on vertex, ocular margins white, sides with flat white scales; nape with erect, forked black scales. Tori brown with white scales on inner sides, antennae dark brown, the "second" segment with some white scales on inner surface. Palpi one-fifth the length of proboscis, black, with some white scales at tip. Proboscis dark brown with many pale scales.

Thorax. Mesonotum with deep brown integument, lined with two median stripes anteriorly, darker than surrounding integument; vestiture of straw-colored and coppery scales, the paler ones along anterior and anterolateral margins as well as about antescutellar space and in obscure longitudinal stripes. Scutellum with yellowish brown scales and brown bristles. Pleurae and coxae paler than mesonotum with a whitish "bloom" and straw-colored scales and pale bristles. Femora dark scaled above and pale scaled beneath, white at tip; tibiae narrowly dark scaled above, pale under-area encroaching on sides; tarsi unbanded with a few scattered yellowish scales. Claws simple, -0.0-0.0-0.0. Wing scales dark brown with a few white ones along costal area. No tendency toward spotting; white scales so closely appressed that whole wing has peculiarly clear, unscaled appearance. Basal cross-vein from one-half to its whole length distant from anterior cross-vein; both cross-veins scaled. Lenth of wing 6.5 to 7.5 mm. Halteres straw-colored with dark knobs.

Abdomen. Dorsal vestiture of brownish black scales with very broad, irregular, basal bands of yellowish scales widening on sides to form irregular lateral stripe; first and eighth segments largely pale scaled. Ventral vestiture of soiled straw-colored scales. Body length 6.0 to 7.0 mm.

MALE. Coloration of male often much paler than that of female, yellowish portions of female becoming accentuated in male and dark scaled portions assuming a distinct brown. Palpi slightly longer than proboscis, last segment thickened toward its apex; segments with brown, yellow, and white scales intermixed. Basal cross-vein generally its own length or more from anterior cross-vein. Fore- and midtarsal claws toothed, hind claws simple, -2.1-2.1-0.0.

Terminalia (fig. 10). Basistyles stout, about one and one-half times as long as their width at base; apical lobes not present as prominences but one or two stout, differentiated setae present at site of these organs; basal lobes present with two apical setae and many smaller ones; phallosome with two upstanding, narrow, projections bearing apical retrorse spurs; parameres present. Paraprocts with strong, narrow chitinizations expanding at tip with a furcation. Basal lobes of ninth tergite well developed with strong spines. Spines of eighth tergite absent.

LARVA. Air tube two and one-half times as long as its width at base; pecten of fourteen basal teeth, apical ones more widely separated than basal ones, followed by seventeen long hairs reaching to outer fifth of tube; basal true pecten teeth with two, three, or four basal denticules (fig. 11); a pair of hair tufts basally within pecten rows. Anal saddle ringing the segment with two-haired posterior tuft; dorsal brush accompanied by three-haired tuft of equally long branches; ventral brush well developed, with several tufts preceding the plate ventrally. Anal gills slightly shorter than segment, acutely pointed. Comb scales of eighth abdominal segment numerous in a triangular patch, each scale with broadly spatulate apex and even fringe of well developed thorns (fig. 11). Mental plate roundedly triangular, teeth subequal, those at margin stoutest although last one minute. Dorsal head hairs multiple, lower pair with three of the five or six hairs stouter and longer. Antennae slightly and uniformly tapered and sparsely spined, multiple tuft before the middle; apical armature of two subequal setae inserted subapically, and apically a short seta, a conelike rod, and a palpus-like digit, membranous apically and chitinous at its base.

The broad, clear wings of *Theobaldia inornata* (Will.) give it a characteristic habitus. Like *Theobaldia incidens* (Thom.), it breeds throughout the year wherever open pools are present in wooded areas. As is the case with all other members of the genus *Theobaldia,* it seldom attacks man and is commonly seen to suck plant juices. The larvae are robust, hairy, and distinguishable from *Theobaldia incidens* (Thom.) only by microscopic examination.

The species ranges over the entire Nearctic region except in the far north. In California, it is taken only rarely in the northern half but to the south it becomes increasingly numerous until, south of the Tehachapi, it is the predominating species.

Theobaldia (Theobaldia) impatiens (Walker)

Culex impatiens Walker, List Dipt. Brit. Mus., vol. 1, p. 5, 1848.
Culex pinquis Walker, Lord's Nat. in Vanc. Is. and B. C., vol. 2, p. 337, 1866.
Culex absobrinus Felt, Bull. 79, New York State Mus., p. 318, 1904.
Culiseta absobrinus Felt, Bull. 79, New York State Mus., p. 391c, 1904.

FEMALE. *Head.* Integument dark brown; occiput with a few narrow, curved, straw-colored scales, ocular margins narrow, white with black bristles, sides with flat white scales; nape with many black, erect, forked scales. Tori brown with some pale scales within; antennae brown. Palpi one-fifth the length of proboscis, brown with some yellow scales. Proboscis dark brown.

Thorax. Integument of mesonotum dark brown; vestiture of metallic brown and yellowish scales sparsely distributed, the pale scales forming complicated and variable patterns but always with two subdorsal pale patches at the middle of mesonotum joined to antescutellar region by two fine pale lines, and generally some pale patches on anterior margin and around antescutellar space. Scutellum with straw-colored scales and dark brown bristles. Pleurae and coxae with a paler integument than that of mesonotum, with straw-colored scales and dark bristles. Femora blackish above, yellow beneath, the dark scales encircling segment near apex; knees yellowish; tibiae with dark scales nearly encircling segment, yellow underpart narrow, tips banded with yellow, wide on the fore- and mid-legs, narrow on hind tibiae; tarsi black scaled. Claws simple, 0.0-0.0-0.0. Wing scales brown, more dense at bases of second and fourth veins and at forks of second and fourth causing an indistinct spotting; cross-veins nearly in a line, wing membrane on either side of them very slightly stained with brown. Length of wing 5.0 to 7.0 mm. Halteres brownish, knobs darker.

Abdomen. Dorsal vestiture of black scales with bands widening at sides on sixth and seventh segments, first and eighth segments entirely pale scaled. Ventral vestiture of soiled yellow scales. Length of body 4.5 to 6.5 mm.

MALE. Coloration as in female except erect, forked scales of nape lemon color, black ones restricted to sides. Vestiture markedly scantier. Cross-veins more widely separated. Palpi same length or slightly longer than proboscis, last segment thickened apically, vestiture of all segments uniformly brown. Claws of fore- and mid-tarsi toothed, those of hind tarsi simple, -2.1-2.1-0.0. Body length 5.5 to 6.5 mm.; wing length 5.5 to 6.5 mm.

Terminalia. Basistyles stout, about one and one-quarter times as long as their width at base, indication of lacunae as in *Aëdes;* dististyles slightly swollen at base; apical lobes represented by setose areas; basal lobes prominent, cone-shaped, densely setose with single heavy spine at apex. Phallosome conical, truncate, dorsal side shorter, lateral plates contiguous on both dorsal and ventral sides; parameres broad, band-shaped. Paraprocts erect, outward curving at apex, apical margin with chitinization serrate, teeth five to seven in number and slightly recurved at tip. Lobes of ninth tergite shallow, with a few long, slender setae. Eighth tergite with a row of short, stout spines medianly about as long as base of phallosome.

LARVA. Air tube about two and one-half times as long as its width at base; pecten of fourteen basal teeth followed by seventeen elongate ones which become simple hairs apically, teeth of true basal pecten short with three basal denticules; pair of multiple hair tufts basally on air tube, between pecten rows. Anal saddle ringing segment, bearing a two-haired posterior tuft; dorsal brush accompanied by a three-branched hair, ventral brush well developed with small tufts anterior to plate. Comb scales of eighth abdominal segment numerous in a triangular patch, each scale slightly expanded apically with an even fringe of long thorns. Mental plate triangular, teeth subequal. Dorsal head hairs multiple, of equal length and stoutness. Antennae slightly and uniformly tapered, a multiple tuft before the middle, sparsely spined, apical armature of two moderate subequal setae inserted subapically, and apically a short seta, a conelike rod, and a palpus-like digit, membranous at tip and chitinous basally.

The adults of *impatiens* are not liable to be confused with any other Californian cogeneres except possibly *inornata* which also has unbanded tarsi.

This mosquito has been taken in California, but rarely. It has frankly abandoned its generic habits of continuous breeding and hibernates as an adult female. It frequents pools similar to those chosen by *Theobaldia inornata* (Will.)—dark, clear, woodland pools of semipermanent character. Dyar (1922) records the collection of this species at Lake Tahoe. The writer is able to add Thermalito, Butte County, May, 1920; and Lake Merced, Yosemite National Park, June, 1921.

The range of this mosquito is throughout the Canadian forests from coast to coast extending up the Pacific Slope to Alaska and south through the Sierra. On the Atlantic coast it extends into northern New York and New England.

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Neomacleaya Theobald, Mon. Culic., vol. 4, p. 228, 1907.
Protomacleaya Theobald, Mon. Culic., vol. 4, p. 253, 1907.
Banksinella Theobald, Mon. Culic., vol. 4, p. 468, 1907.
Mimeteculex Theobald, 3d Rept. Wellcome Res. Lab., p. 258, 1908.
Geitomyia Leicester, Stud. Ins. Med. Res., Fed. Malay Sta., vol. 3, pt. 3, p. 134, 1908.
Aioretomyia Leicester, Stud. Ins. Med. Res., Fed. Malay Sta., vol. 3, pt. 3, p. 185, 1908.
Kingia Theobald, Mon. Culic., vol. 5, p. 135, 1910.
Myxosquamus Theobald, Mon. Culic., vol. 5, p. 225, 1910.
Nepecomyia Theobald, Mon. Culic., vol. 5, p. 261, 1910.
Stenoscutus Theobald, Mon. Culic., vol. 5, p. 263, 1910.
Bathosomyia Theobald, Mon. Culic., vol. 5, p. 135, 1910.
Molpemyia Theobald, Mon. Culic., vol. 5, p. 479, 1910.
Leslieomyia Christophers, Paludism, no. 2, p. 68, 1911.
Andersonia Strickland, Entom., vol. 44, p. 250, 1911.

This genus includes nearly one-half of the Californian culicids. Ecologically, they are divided into the salt marsh breeders, the floodwater species, and the mountain forms. Some interchange of habitat occurs in one or two species but in the main their presence in California can be predicted by their habitat. The general characteristics of which all Californian species partake are as follows:

Adult. Eyes distinctly separated above antennae. Female palpi very short, less than one-fourth the length of proboscis. Proboscis flexible and of uniform thickness. Prothoracic lobes separated dorsally. Prespiracular bristles absent. Wing membrane with distinct microtrichia. Pulvilli absent; claws of fore- and mid-legs and generally those of hind legs of females toothed. Posterior abdominal segments progressively smaller, giving tapering aspect to abdomen; eighth segment retracted for at least half its length within the seventh segment. Cerci of female exerted and generally prominent. Basistyles of male terminalia with a chitinous invagination along inner sides for entire length; diststyles articulated to lie in a horizontal plane.

Larva. Anal siphon stout, ranging from 2.5 × 1 to 4 × 1; pecten well developed; single hair tuft on each side at or beyond the middle, generally just distad to end of pecten if latter has no detached teeth, in which case generally occupies that position with respect to basal or main portion of pecten. Comb scales present on eighth segment. No chitinous plates present on abdomen or thorax except for breathing tube, chitinous saddle of anal segment, and circular insertion plates of hairs. Antennal hair tuft near the middle of antenna.

The California species are divided into four subgenera—*Ochlerotatus* (=*Heteronycha*), *Aëdes*, *Aëdimorphus* (=*Ecculex*) and *Culicelsa* (=*Taeniorhyncus*).

KEY TO THE SUBGENERA OF CALIFORNIAN AEDES

Male Terminalia

1. Claspette elongate 2
   Claspette lobe-like .... **Aëdimorphus** Theob.
2. Claspette furcate .... **Aëdes** Meigen.
   Claspette simple 3
3. Basistyle with both basal and apical lobes............ **Ochlerotatus** L.-A.
   Basistyle without apical lobe .... **Culiselsa** Felt.

Larval Characters

1. Hair tuft of air tube tube distinctly beyond the middle 2
   Hair tuft of air tube at or near the middle 3
2. Head hair arranged in anterior and posterior pairs .... **Aëdimorphus** Felt (**vexans** [Meig.])
   Head hairs arranged approximately in a transverse line............ **Aëdes** Meig.
3. Antennae smooth, without spines............ **Culiselsa** Felt (in part = **varipalpus**).
   Antennae spinose .... **Ochlerotatus** L.-A. (in part = **taeniorhyncus** [Wied.])

KEY TO CALIFORNIAN SPECIES OF AEDES

Adults

1	Tarsi with white rings at both ends of segments	2
	Tarsi with white rings at bases of tarsi only	4
	Tarsi without pale rings	8
2	Wing scales bicolored	**dorsalis** (Meig.)
	Wing scales unicolorous	3
3	Small, dark mosquito with very prominent snowy white tarsal rings	**varipalpus** (Coq.)
	Medium sized, brown mosquito, with creamy yellow tarsal rings	**dorsalis melanimon** Dyar
4	Proboscis completely white ringed	**taeniorhyncus** (Wied.)
	Proboscis not completely white ringed, if at all	5
5	Tarsal rings very minute, abdominal pale bands indented on dorsal line	**vexans** (Meig.)
	Tarsal rings normal, abdominal bands straight or produced	6
6	Wing scales broad and swollen	**squamiger** (Coq.)
	Wing scales normal	7
7	Wing scales chiefly black	**increpitus** Dyar
	Wing scales with many white ones	**fitchi palustris** Dyar
8	With continuous white line laterally on abdomen or lateral spots tending to form such a line	9
	Without this marking	10
9	Mesonotum uniformly brown	**cinereus fuscus** O.S.
	Mesonotum with darker lines	**cinereus hemiteleus** Dyar
10[5]	Mesonotum with paired brown lines	11 (see **ventrovittis** under No. 12)
	Mesonotum without paired brown lines	12
11	Mesonotum yellowish at the sides	**hexodontus** Dyar
	Mesonotum gray at the sides, medium sized mosquitoes, 4.7 mm.	**communis tahoensis** Dyar
	Mesonotum gray at the sides, small mosquitoes, 4 mm.	**impiger** (Walk.)
12	Mesonotum olive brown, sometimes with diffuse paired lines, basal abdominal white bands minutely constricted medianly, general appearance black	**ventrovittis** Dyar
	Mesonotum gray with some brown centrally, basal abdominal white bands broad and not constricted, without black appearance	**cataphylla** Dyar

Larvae

1	Pecten with detached teeth	2
	Pecten without detached teeth	5
2	Pecten teeth present beyond the hair tuft	**cataphylla** Dyar
	Pecten teeth not present beyond the hair tuft	3
3	Air tube short and stout, 2 × 1	**ventrovittis** Dyar
	Air tube normal	4
4	Lower head hairs double	**vexans** (Meig.)
	Lower head hairs multiple	**cinereus fuscus** O.S., **hemiteleus** Dyar
5	Comb scales of the eighth segment with an apical tooth stouter than the rest	6
	Comb scales of the eighth segment without an apical tooth differentiated from the rest	9

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[5] Dichotomy 10 is weak and will not separate the aberrant forms of this plastic group of "black legged" *Aedes*.

6. With apical spine of the comb scales of the eighth segment strongly differentiated, the rest of the fringe reduced to minute lateral spinules .... **hexodontus** Dyar.
   With apical spine of the comb scales of the eighth segment not *strongly* differentiated, those near the apex nearly as long as the apical one 7
7. Air tube long and slender, 4 × 1 .... **fitchi palustris** Dyar.
   Air tube short and stout, 2.5 × 1 8
8. Upper head hairs single .... **impiger** (Walk.)
   Upper head hairs multiple .... **increpitus** Dyar.
9. Anal saddle ringing the segment .... **taeniorhyncus** (Wied.)
   Anal saddle not completely ringing the segment 10
10. Anal gills long, well developed 11
    Anal gills short, globular 12
11. Anal gills pointed; spines of comb scales well developed .... **communis tahoënsis** Dyar.
    Anal gills spatulate; spines of comb scales minute .... **varipalpus** (Coq.)
12. Dorsal head hairs generally single.. **dorsalis** (Meig), **dorsalis melanimon** Dyar.
    Dorsal head hairs double .... **squamiger** (Coq.)

Male Terminalia

1. Claspettes elongate 2
   Claspettes lobe-like (subgenes *Aëdimorphus*) .... **vexans** (Meig.)
2. Claspettes furcate (subgenus *Aëdes*) .... **cinereus fuscus** O.S., **cinereus hemiteleus** Dyar.
   Claspettes not furcate 3
3. Basistyles with both basal lobe and apical lobe (subgenus *Ochlerotatus*)........ 4
   Basistyles with basal lobes only (subgenus *Culiselsa*) 12
4. Basal lobe with two outstanding spines 5
   Basal lobe with one outstanding spine, or if none with the lobe wrinkled and appressed 6
5. Outer spine of two outstanding spines stout .... **dorsalis** (Meig.)
   Outer spine of two outstanding spines slender, hairlike .... **dorsalis melanimon** Dyar.
6. Setae of apical lobe short and appressed 7
   Setae of apical lobe normal 8
7. Spine of basal lobe heavy .... **hexodontus** Dyar.
   Spine of basal lobe weak .... **ventrovittis** Dyar.
8. Setae of apical lobe directed outwardly 9
   Setae of apical lobe directed inwardly 10
9. Apical lobe distinctly setose .... **communis tahoënsis** Dyar.
   Apical lobe with few setae .... **impiger** (Walk.), **cataphylla** Dyar.
10. Basal lobe flat, without spine or tuft of setae .... **increpitus** Dyar.
    Basal lobe conical, spine present in clump of setae 11
11. Terminal appendage of the claspette short, sickle-shaped .... **fitchi palustris** Dyar.
    Terminal appendage of the claspette long, centrally widened .... **squamiger** (Coq).
12. Terminal appendage of the claspette with retrorse spur .... **taeniorhyncus** (Wied.)
    Terminal appendage of claspette without retrorse spur........ **varipalpus** (Coq.)

Subgenus **Ochlerotatus** Lynch-Arribalzaga[6]

This subgenus includes nine of the thirteen species of Aëdes present in California. The majorty of these are mountan breeders in California because of the presence there of favorable ecological conditions, but the same species may be present at sea level in other areas if the climatic conditions are suitable. The subgenus has been divided into ten groups on the basis of the male terminalia. Four of these groups are represented in California and may be separated as follows:

1. Basal lobe expanded, with many setae and two differentiated stout spines .... Group **dorsalis, Aëdes dorsalis** (Meig.)
   Basal lobe with or without a single differentiated spine, if without, the lobe is flat and wrinkled 2
2. Apical lobe with short, appressed setae .... Group **punctor, Aëdes ventrovittis** Dyar, **Aëdas hexodontus** Dyar.
   Apical lobe with normal setae 3
3. Setae of apical lobe directed outwardly .... Group **impiger, Aëdes impiger** (Walk.), **Aëdes cataphylla** Dyar, **Aëdes communis tahoënsis** Dyar.
   Setae of apical lobe directed inwardly .... Group **stimulans, Aëdes increpitus** Dyar, **Aëdes fitchi palustris** Dyar, **Aëdes squamiger** Coq.

These groups may be distinguished in the females by the banding of the tarsal segments at both base and apex (group *dorsalis*), the banding at the bases only (group *stimulans*), and no banding (groups *impiger* and *punctor*).

The distribution of the subgenus is interesting in that it is the predominating Holarctic group. It is absent in the Oriental and Ethiopian faunas and yet appears abundantly in tropical America, southern Australia, and New Zealand. Edwards (1921) is authority for the statement that the affinities between the South American forms and those of Australia and New Zealand are striking. This phenomenon is common and is explained by the "fixed continentalists" by the equal urge away from a Holarctic point of dispersal, but the absence in the intervening areas between the Palearctic and the Antipodes is hard to explain.

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[6] *Heteronycha* L-A., which has been widely used for this subgenus, was suggested by Lynch-Arribalzaga with the type species *dolosa*, which proved to be based on the males of *Culex bonariensis* Brethes, and the females of *Aëdes lynchi* Brethes. Theobald, the first reviser, attached the type of this combination to the *Culex* element, thus outlawing the use of *Heteronycha* for a group of *Aëdes*. *Ochlerotatus* L-A., antedated by *Heteronycha* only by page precedence, has the advantage of a definite type species, *Ochlerotatus confirmatus* L-A. (= *scapularis* Rond.).

Group **dorsalis**

The group is represented by a single species in California—*Aëdes dorsalis* (Meig.) and its aberrant form *dorsalis melanimon* Dyar. Two other species, *Aëdes canadensis* Theob., and *Aëdes campestris* D. & K. occur in the United States, the former ranging from the forested area of southern Canada to the Gulf of Mexico and the latter from Utah and Montana northward to Alaska. Several species, including *Aëdes dorsalis* (Meig.), have a Palearctic range. Chief among these is *Aëdes caspius* (Pallas), which occurs from the Gobi desert westward across the European plain extending northward to the Scandinavian peninsula and southward to the Punjab, the Persion Gulf, and the deserts of northern Africa. Its larvae, like those of *dorsalis*, are facultative to both fresh, salt, or brackish water.

Aëdes (Ochlerotatus) dorsalis (Meigen)

Culex dorsalis Meigen, Syst. Besch. Bek. Eur. Zweifl. Ins., vol. 6, p. 242, 1820.
Culex maculiventris Macquart, Dipt. Exot., suppl., vol. 1, p. 7, 1846.
Culex curriei Coquillett, Canad. Entom., vol. 33, p. 259, 1901.
Culex onondagensis Felt, Bull. 79, New York State Mus., p. 278, 1904.
Aëdes quaylei Dyar and Knab, Jour. New York Entom. Soc., vol. 14, p. 191, 1906.
Culex lativittatus Coquillett, Entom. News, vol. 17, p. 109, 1906.
Grabhamia mediolineata Ludlow, Canad. Entom., vol. 39, p. 129, 1907.
Grabhamia broquetti Theobald, Entom., vol. 46, p. 154, 1920.
Aëdes grahami Ludlow, Ins. Ins. Mens., vol. 7, p. 154, 1920.
Aëdes melanimon Dyar, Ins. Ins. Mens., vol. 12, p. 126, 1924.

FEMALE. *Head.* Integument dark; occiput clothed with dense covering of sordid white, narrow, curved scales, with flat, brown ones along the sides; nape with many erect forked scales of sordid white. Proboscis uniform with dark brown scales, cluster of white ones at middle beneath sometimes giving appearance of a ring. Palpi one-fourth the length of proboscis with black and white scales, the former predominating. Tori blackish brown, inner faces with patch of white scales; segments of antennae black, except for the "second" segment which has basal half pale.

Thorax. Mesonotum brown; vestiture of narrow, curved, white scales with three narrow stripes of bright brown starting from anterior margin at both sides and in the median line and progressing posteriorly; with similar posterior stripe on each side of antescutellar space; many short brownish bristles. Scutellum trilobate, straw-colored with large white scales and clump of pale bristles on each lobe. Postscutellum brown with a gray bloom. Pleurae brown with dense coat of flat white scales and many pale bristles. Femora with black and white scales, the black predominating distally but with white knee spots; tibiae with black and white scales intermixed; tarsi of forelegs with basal and apical bands on first segment, basal bands on second, the rest dark; tarsi of mid-legs with bands at bases and apices of first and second segments, the rest dark; tarsi of hind legs with bands at bases and apices of all segments, the last ones wholly white. Claws toothed -1.1-1.1-1.1. Wings with both black and white scales, the former predominating and the latter generally confined to base of wing and costal margin, but may occur well distributed over wing. Length of wing 4.5 mm.

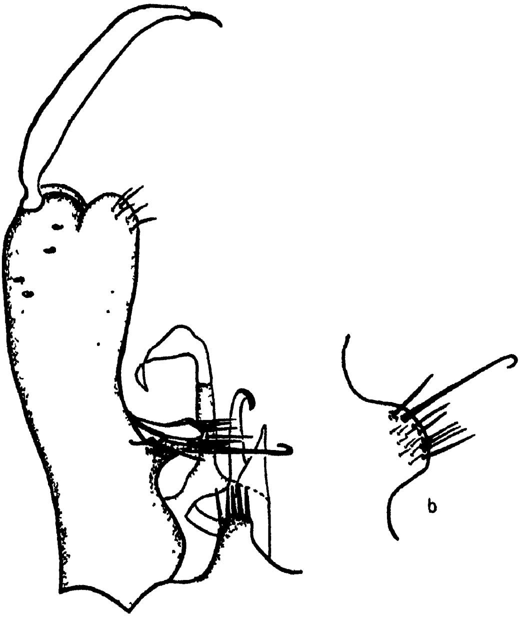

Fig. 12. *Aëdes dorsalis melanimon* Dyar. (*a*) Male terminalia. (*b*) Appearance of basal lobe when flattened in a balsam mount. The outer spine of the basal lobe is much stouter in *Aedes dorsalis* (Meig.), approaching or exceeding the thickness of the long spine.

Abdomen. Dorsal vestiture of flat white scales with two quadrate black patches on each segment except first and last. Ventral vestiture of flat white scales with a median basal, black spot and two subapical, sublateral smaller spots on each segment. Cerci black.

MALE. Coloration similar to female except that not so dense or distinct. Palpi longer than proboscis, with last segment swollen. Antennae black at insertion of hair whorls which are blackish brown, the last two segments long and with black pilosity. Claws toothed 2.1-1.1.-1.1.

Terminalia (fig. 12). Basistyles columnar with well developed apical lobes and deep lacunae; apical lobes with normal setae. Dististyles slender, curved, with long terminal spines. Basal lobe strongly developed with vestiture of exceedingly coarse setae, two of which decidedly stouter; one of these stout spines long and recurved at tip, the other short and conical. Claspette shaft short and columnar, reaching only to apex of basal lobe; claspette appendage as long as shaft, expanded at middle on one side and pointed at tip. Paraprocts short, heavily chitinized, and recurved at tip. Phallosome short, stout and conelike. Lobes of ninth tergite inconspicuous with tuft of weak spines.

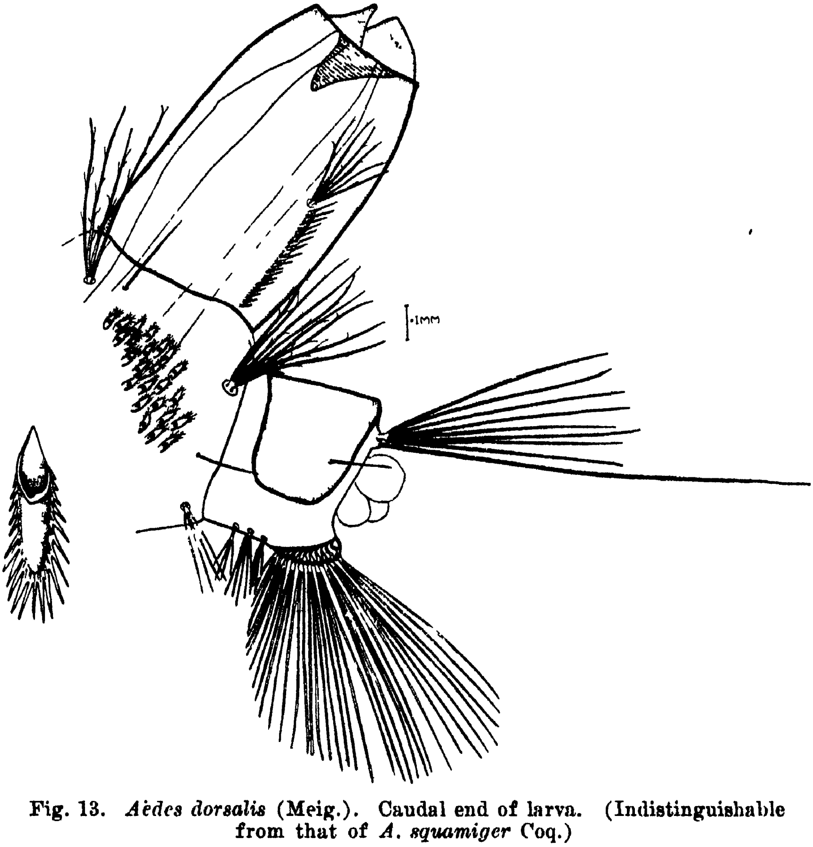

Fig. 13. *Aëdes dorsalis* (Meig.). Caudal end of larva. (Indistinguishable from that of *A. squamiger* Coq.)

LARVA (fig. 13). Air tube short and stout, 2 × 1; tracheal ampoules broad; pecten of seventeen evenly spaced teeth, each tooth with two to four denticules at base, one of which stouter than rest; hair tuft of tube 6-haired, situated midway of tube just distad of end of pecten. Anal saddle not ringing the segment; with a single hair ventrally and posteriorly. Dorsal hair of anal segment long, dorsal brush an 8-haired tuft, moderate in length. Ventral brush long, well developed, with three hair tufts preceding the plate. Anal gills round, globular. Comb scales of eighth segment in a triangular patch, about twenty-six in number; each scale slipper-shaped with narrow heel, and even fringe of thorns on toe end produced from a common margin surrounding this end of scale; apical thorns larger and longer but without a single outstanding thorn. Mental plate conical, teeth subequal.

Upper head hairs long, prominent, single; lower head hairs single. Antennae slender, slightly and uniformly tapered, sparsely spinose, a 6-haired tuft at middle; apical armature consisting of a long and a short spine subapically inserted, and apically a short spine, a cone-shaped rod, and a palpus-like appendage with base chitinous and apex membranous.

Head hairs generally single, but may both be double, in which case larvae are indistinguishable from those of its co-breeder, *Aëdes squamiger* (Coq.).

The vestiture described is that most commonly encountered among Californian representatives but numerous variations occur which render the species confusing. The mesonotal vestiture is subject to the greatest variation. The three anterior longitudinal stripes sometimes fuse to form a dark quadrate stripe and may vary in color from light coppery brown to almost black. The whitish scales at the shoulders and on the pleurae often become coppery, straw-colored, or even brown and in many instances these white scales which are normally grayish become snow white. The normal aspect of the mosquito is straw-colored and varies in both directions to almost white or a somber brown. The variations in abdominal vestiture have led to the foundation of two species which were, of course, untenable. The line of white scales which separates the dorsal black squares may become exceedingly narrow or even be absent, leaving the white scales of the dorsum limited to narrow dorsal bands. On the other hand, the black patches may be reduced to mere spots, in which case the dorsum appears almost entirely white scaled. Ventrally the median black spots may become elongated to form a median black stripe.

In a general way, the lighter colored forms appear from the salt marshes and the arid regions. Those with the dark coloration occur in the more humid, fresh-water areas in company with *Aëdes vexans* (Meig.) which they superficially resemble, particularly in the males. Wesenburg-Lund (1921), on account of the variability and overlapping of this spècies with *Aëdes* (*Ochlerotatus*) *caspius* (Pallas), has questioned the validity of *Aëdes dorsalis* (Meig.) as a distinct species. Edwards (1921) who has had the opporunity to study comparative material is still of the opinion that they are distinct, in which opinion I must concur through ignorance of *caspius* although the variations of the mesonotum and male terminalia upon which the distinctions are made occur regularly with our Californian *dorsalis*. *Aëdes caspius* (Pallas) (Reise versch. Prov. Russ. Reichs. I, p. 475, 1781) antedates *Aëdes dorsalis* (Meig.) (1830), and will replace the latter if later investigations prove the two species to be identical.

Coquillet in 1901 described this species from North Dakota as *Culex curriei,* considering it distinct from the European *dorsalis* on account of Theobald's misstatement that this species has simple claws. In 1904, Felt described the same species from New York as *Culex onondagensis* and in 1906 Dyar and Knab, and also Coquillet named the salt marsh breeder of the Californian coast, the former as *Aëdes quaylei* and the latter as *Culex lativittatus.* Dyar later placed these all in synonomy with *Aëdes dorsalis* (Meig.) of Europe.

Dyar (1924*a*) has recently described a new Aëdes from Bakersfield, California, under the name of *Aëdes melanimon.* He separates the species from our common *Aëdes dorsalis* (Meig.) on account of its unicolorous wing scales and the characters of the male terminalia. *Aëdes dorsalis* (Meig.) is characterized by having a mixture of pale and dark scales in the anterior portion of the wings particularly on the first, third, and fifth veins. The male terminalia have a blunt, quadrate basal lobe and the expansion of the filamentous appendage of the claspette is not pronounced. The new species is said to have the wing scales all dark or, at least, unicolorous, with the basal lobe of the basistyle rounded and sparsely haired, and the appendage of the claspette with a decided expansion.

We have available several hundred specimens that were sent in for identification by Major C. K. Badger, who supplied Dr. Dyar with his material, and which we had previously determined, without mounting the terminalia, as *Aëdes dorsalis* (Meig.). Hoping that we might discover some of the new species, we went over the material again and found one box of very dark specimens with the wing scales unicolorous although not so dark as some of the dark scales on typical *dorsalis* imagines. When some of the males had been relaxed and their terminalia slightly cleared in potash and examined in alcohol, they seemed to be typical of *dorsalis.* In alcoholic preparations of this species the basal lobe appears as a very thin, flat, membranous shelf with the setae arranged at its outer edge (fig. 12 *a*). As the new species had a rounded lobe, we were prepared to look farther but delayed to mount in balsam the terminalia already prepared. Much to our surprise, after mounting them, we found that ten of twelve mounts, which had shown a shelf-like basal lobe in alcohol, appeared to have beautifully rounded lobes similar to the sketch Dr. Dyar had sent us of his new species. In flattening out the terminalia in the mount, the delicate shelf of the basal lobe folds over through an angle of 90 degrees, bringing the face that is normally directed toward the body of the mosquito to the upper surface, as shown in figure 12 *b*.

The shape of the basal lobe as prepared in balsam mounts is identical with that figured for *Aëdes caspius* (Pallas) but the vestiture of this race does not conform to Edward's description. We believe, however, that we are dealing with one plastic species that includes *caspius, dorsalis,* and *melanimon,* but, not having made any comparisons with the actual European specimens, we prefer for the present to disregard the possibility of including *caspius* in the complex and merely to consider that *melanimon* is a race of *dorsalis.*

Despite the variation that renders this species so confusing, it may be readily separated from all other *Aëdes* except *varipalpus* by the double banding of the hind tarsi. Its larger size, general straw color, and bicolored wing scales separate it easily from the small, dark *varipalpus* with its uniformly black wing scales.

This mosquito is the commonest species of the Californian coast from Monterey northward. South of this point, it is replaced in the salt marsh regions by *Aëdes taeniorhyncus* (Wied). As a fresh-water breeder it occurs throughout the central valleys in both arid and irrigated sections. Despite opinion to the contrary, it is decidedly a flood-water species wherever the flood waters are in the open. Its inland range in California dovetails into that of *Aëdes vexans* (Meig.), *dorsalis* inhabiting the open pools and *vexans* those that are wooded. Its larvae are extremely facultative, breeding in all kinds of natural, transient, and semipermanent pools, the only limiting factor apparently being the presence of shade, of which it is not tolerant.

The salt marsh breeding is in distinctly brackish water, generally in pools reached only by the monthly "rip" tides, thus assuring an undisturbed month, if necessary, for development. The larvae, however, are not limited to these pools for they may be found breeding in brackish pools not reached by the daily tides. Although it has not been proved definitely, it is evident that the eggs require a resting period of at least six months for development before hatching. New pools, artificially formed, are apparently free from larvae of this species during the first season, although they may be identical in appearance and composition with infested pools. Another factor supporting this assumption is the replacement in midsummer of *dorsalis* by *squamiger* with its rather scanty reappearance late in the fall. If the eggs deposited on each monthly emergence hatched on the next submergence, the increase in numbers should be steady instead of receding after an early summer peak. The eggs do not all hatch at the first wetting. This is possibly on account of a varying thickness of the chorion. This phenomenon, common in weed seeds, serves as a protection to the species in case of the premature drying of the pools and also serves to explain the continued presence of larvae at successive tides without dependence on the egg deposition made during the immediately preceding flight. Circumstantial evidence points to the occurrence of two main generations a year, one in the early spring and summer emanating from eggs laid the preceding year and a minor brood in the autumn from eggs laid in the spring. Sporadic breeding also takes place during the late summer and in some cases during the winter.

The members of the species breeding in fresh water are widely distributed over the central valleys of California. They breed in wayside pools, in grassy pools caused by negligent irrigation, and in flooded aforested meadows, and are the most abundant species in the rice fields during the first of the season. The only general characteristics which can be stated for the breeding pools of this species are that they are generally transient or fluctuating in level, and located in open, level, unshaded areas. Although normally present in the arid country, where they depend on the melting snows or scanty rains for breeding areas, they easily adapt themselves to the advent of irrigation, and under such conditions become extremely abundant. For this reason the species is on the increase in California. Although from early days a serious pest in the salt marshes and the peat bogs of the Delta country, it is only within comparatively recent years, in connection with the increase of irrigation and the introduction of rice, that they have risen to the importance of being the most troublesome non-malaria-bearing mosquito of the central valleys.

Group **punctor**

This group is represented in California by two species, *Aëdes hexodontus* Dyar and *Aëdes ventrovittis* Dyar, both of which are restricted to the Sierra. The members share with those of group *impiger* the designation of "black-legged" *Aëdes* on account of the absence of tarsal white bands. On the basis of the male terminalia, the Nearctic members of the group divide into two series known as the *punctor* and *spenceri* series. Both Californian species belong to the *punctor* series.

Aëdes (Ochlerotatus) hexodontus Dyar

Aedes hexodontus Dyar, Ins. Ins. Mens, vol. 4, p. 83, 1916.

FEMALE. *Head.* Integument black; occiput with narrow, curved, lemon-colored scales on vertex, those at side flat and slightly paler; a cluster of pale bristles between eyes, those bordering eyes black; nape with black, forked scales. Proboscis uniform with dark brown scales. Palpi short and dark brown. Antennae dark.

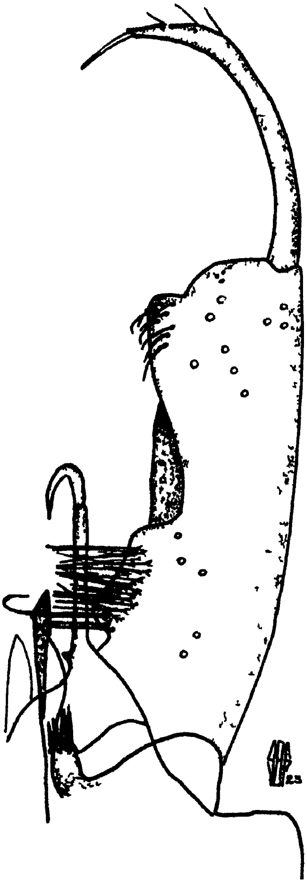

Fig. 14. *Aedes hexodontus* Dyar. Male terminalia.

Thorax. Integument dark; vestiture of mesonotum of straw-yellow, narrow, curved scales with brown ones medially, a bare median groove flanked by row of yellow bristles on each side followed by wider row of bright brown, narrow, curved scales, those of ante-scutellar space being nearly white. Halteres dark brown. Pleurae dark brown with flat white scales and pale bristles. Coxae slightly paler than pleurae, bearing white flat scales and pale bristles. Femora whitish beneath with narrow, white knee spots; tibiae whitish beneath; tarsi without bands, generally entirely dark but sometimes with light scales beneath. Tarsal claws toothed 1.1-1.1-1.1. Wing scales uniformly black. Length of wing 4.8 mm.

Abdomen. Dorsal vestiture of dark brown scales with narrow, even, basal, segmental white bands. Venter entirely white scaled except for small median black spots and sometimes subapical and sublateral spots. Cerci black. Length of body 4.9 mm.

MALE. Coloration as in female except that black, ventral abdominal markings are generally more pronounced. Palpi slightly shorter than proboscis, last two segments and the end of long segment swollen.

Terminalia (fig. 14). Dististyles slender, evenly tapered, with terminal claws. Basistyles columnar, with deep lacunae, apical lobes normally developed and bearing short appressed setae. Basal lobes prominent, with many setae and proximally a differentiated spine recurved at tip. Claspette with shaft upright, slender, minutely setose on basal half, appendage narrow, sickle-shaped, slightly over half the length of shaft. Paraprocts upright, heavily chitinized. Phallosome cone-shaped. Lobes of ninth tergite small with a crown of stout spines.

LARVA (fig. 15). Air tube about two and one-half times as long as its width at base, slightly swollen at middle; tracheal ampoules large; pecten of about fifteen evenly spaced teeth, each tooth with a broad base bearing one or two denticules, then tapering rapidly; a five-haired tuft slightly before the middle. Anal saddle encircling segment, incised for reception of ventral brush. Anal gills normal. Comb scales of eighth segment, eight or nine in number in a roughly triangular patch, each scale made up of a long central thorn with a minute basal fringe. Mental plate obtusely conical, teeth subequal. Antennae minutely and sparsely spined, a multiple hair tuft of about four hairs in the center. Apical armature of a long and a short spine subapically inserted, and apically a short spine, conelike rod, and palpus-like digit, chitinous at base and membranous at apex. Dorsal head hairs variable, generally both double or the lower in threes, but sometimes with uppers single and lowers double or vice-versa.

The larva of *hexodontus* is indistinguishable from that of *punctor*. The adult differs slightly in the male terminalia by having the spine of the basal lobe more strongly differentiated from the accompanying setae. The species also differs in the adult by having two medially divided, brown stripes on the mesonotum which are present as a solid quadrate patch in *punctor*. These brown stripes never coalesce in the Californian species of *hexodontus* into the quadrate patch of *punctor*, but aberrant members of the latter show a division into two stripes, thus producing the coloration of *hexodontus* and leaving only a precarious difference in the form of the spine of the basal lobe.

The yellow aspect of the shoulders and sides of the mesonotum separates the normal members of *hexodontus* from *Aëdes communis* *tahoënsis* Dyar with which it is most commonly confused, the latter having these parts normally gray. Aberrant forms occur, however, by a dulling of the yellow scales or a suffusion of brown ones that renders the adult females inseparable from *tahoënsis* or *Aedes impiger* (Walker). The larvae, however, may be separated from those of *impiger* and *tahoënsis* with which the adults are liable to be confused and from its nearest Californian ally, *Aëdes ventrovittis* Dyar, by

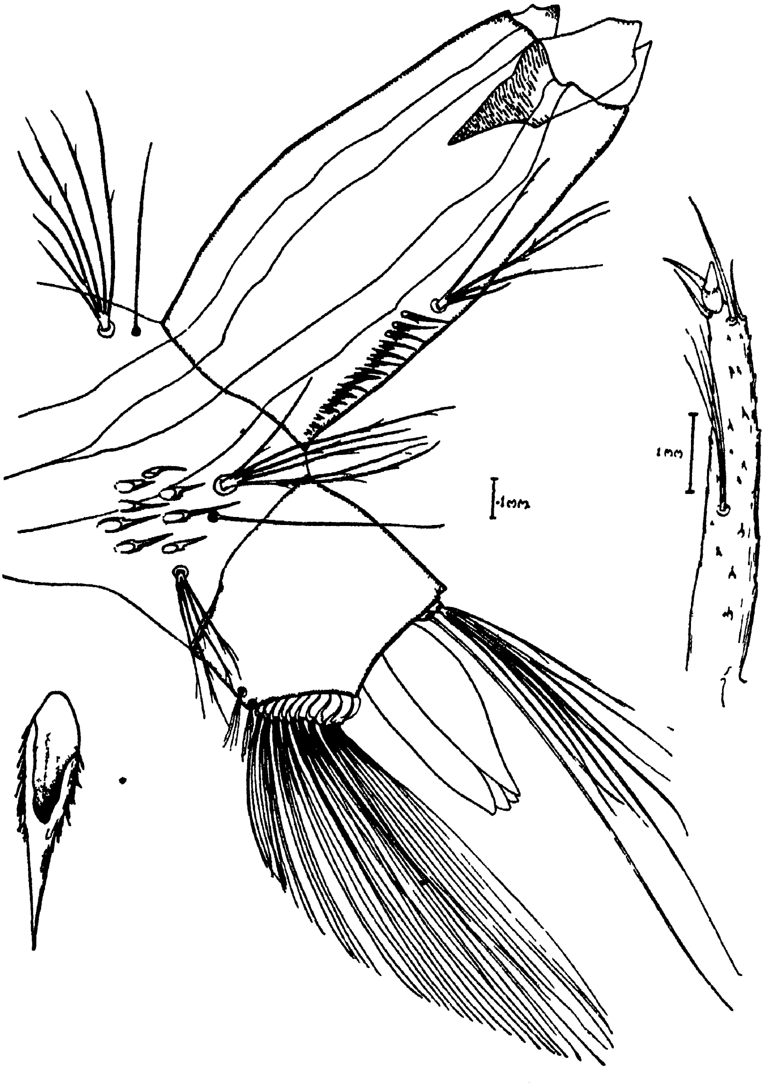

Fig. 15. *Aëdes hexodontus* Dyar. Caudal end of larva and antenna. Enlarged view of a comb scale.

having the anal segment completely ringed by the saddle, it being only partially so in the species mentioned.

Hexodontus breeds in the most insignificant of pools, such as the hoofprints of cattle and tiny depressions of seepage areas. At Echo Lake, about ten miles from its type locality at Fallen Leaf Lake, California, and approximately 1000 feet higher (7500 feet), it utilized a seepage area at the head of the lake which was frequented by cattle. At this point the level of the lake was slightly higher than the area behind the shore line. Although not flooded, this grassy meadow land was dotted with hoofprints which were filled with water and undoubtedly furnished the breeding places for the myriads of *hexodontus* adults that made life unbearable during the day in the immediate vicinity during a visit from June 17–20. No larvae or pupae were present in the pools although the surface was dotted with pupal casts which gave evidence of having been very recently and simultaneously vacated. *Tahoënsis* larvae were still present in small numbers in deeper meadow pools in the same locality.

The species extends northward along the crest of the Sierra through Plumas County and is present in the Crater Lake fauna in Oregon (Dyar). To the south of the Tahoe district it is evidently absent or occurs in limited numbers only. Collections at Yosemite Valley and the High Sierra to the east of the valley have yielded only two questionable females, no bred material of this region having demonstrated its appearance south of the Tahoe district.

Aëdes (Ochlerotatus) ventrovittis Dyar

Aedes ventrovittis Dyar, Ins. Ins. Mens., vol. 4, p. 84, 1916.
Aedes fisheri Dyar, Ins. Ins. Mens., vol. 5, p. 19, 1917.
Aedes ventrovittis Dyar, Ins. Ins. Mens., vol. 8, p. 172, 1920.

FEMALE. *Head.* Integument black; occiput with narrow, curved, cream-colored scales and flat white ones, the latter predominating at sides; brownish, narrow, curved scales and upright, forked scales of light brown and black at nape and a scattering of the latter along sides; eyes outlined with dense white scales. Tori dull black, white scaled within; antennae black with black bristles and a pale pilosity; palpi and proboscis dull black.

Thorax. Mesonotum with integument black; the vestiture of narrow, curved, coppery and straw-colored scales giving an olive tint to whole mesonotum; the coppery scales predominating along median line suggesting a striped condition; scutellum densely clothed with straw-colored scales and pale dark bristles; postscutellum dark brown, nude. Pleurae dark brown, with sparse cream-colored scales and pale bristles, the latter forming dense clumps in postalar and mesepimeral regions but with lower mesepimeral bristles absent. Legs black, femora white scaled within; knees white; tibiae and tarsi with scattering of white scales beneath. Claws toothed -1.1-1.1-1.1. Wing scales predominatingly black but with some white ones; the latter occurring in greatest numbers at bases of veins although present distally in small numbers on the first four veins.

Abdomen. Integument black; basal segment dorsally white scaled with many pale bristles, the rest black with basal white bands widening slightly at sides; a median constriction of these bands may separate them into two lateral white triangles or may be scarcely noticeable; black remainder of dorsal vestiture has brownish tinge suggesting plum color that, once seen, is characteristic for this species, at least in California. Venter entirely white scaled, or with a median, black, funnel-shaped marking, the wider end toward the apices; or with a median stripe and two subapical, sublateral spots.

MALE.[7] "Palpi only slightly exceeding the proboscis, black with long black hairs on the last two joints. Mesonotum black without scales, but with dense black hairs, those posteriorly as well as on the fore coxae long. Abdomen entirely black above and below, densely hairy. Legs black, bronzy brown below. Wing scales black.

"*Hypopygium (Terminalia).* Side pieces [basistyles] three times as long as wide, conical at tips. Apical lobe elliptical, not strongly elevated, clothed with stout recurved clinging hairs. Basal lobe tubercularly expanded, clothed with short, strong, curved setae, becoming longer at the inner angle, where in a dense tuft is a single slender spine with curved tip. Claspette slender, moderate, the filament short, thick, curved and sickle shaped. Ninth tergites [lobes of] moderate, with three long and two shorter spines at the tip."

LARVA (fig. 16). Air tube slightly over twice as long as wide, uniformly tapered; pecten of nine to eleven evenly spaced teeth followed by two detached ones, each tooth with one, sometimes two basal denticules; hair tuft of five or six hairs following pecten at point midway of tube. Tracheal ampoules large, filling tube. Anal saddle not ringing the segment, a single hair laterally and posteriorly. Dorsal hair of anal segment well developed; dorsal brush a seven-haired tuft, moderate in length; ventral brush short and preceded by pair of small tufts ventrally. Anal gills long and pointed. Comb scales of eighth segment six to nine in number, each scale consisting of a heavy thorn, at the base of which are some very minute spinules. Antennae slightly and uniformly tapered, a hair tuft of five hairs at the middle; inner surface clothed with minute spines of two sizes arranged in longitudinal rows, outer surface with the heavier spines; apical armature of a long and short bristle inserted subapically and a short bristle, a conelike rod, and a palpus-like digit, chitinized at base, membranous at tip. Mental plate obtusely conical, teeth subequal. Upper and lower head hairs single.

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[7] The description of the male is that of Dr. Dyar (Ins. Ins. Mens., vol. 8, p. 160) as this form is unknown to the writer.

This small black mosquito is not often confused with ***hexodontus***, its closest ally on the basis of the male terminalia, but may be mistaken for another black-legged *Aedes*—*Aedes cinereus* Meig. It is separated from this species by the fact that the lateral white abdominal spots do not coalesce to form a continuous white line laterally and lines are seldom present on the mesonotum. The larvae may be separated by the fact that the pecten has two detached teeth between the evenly spaced portion and the hair tuft; and the air tube itself is short and stout, scarcely twice as long as the width at the base. The detached teeth of the pecten are unique in the *punctor* group as is the hairy, scaleless condition of the male.

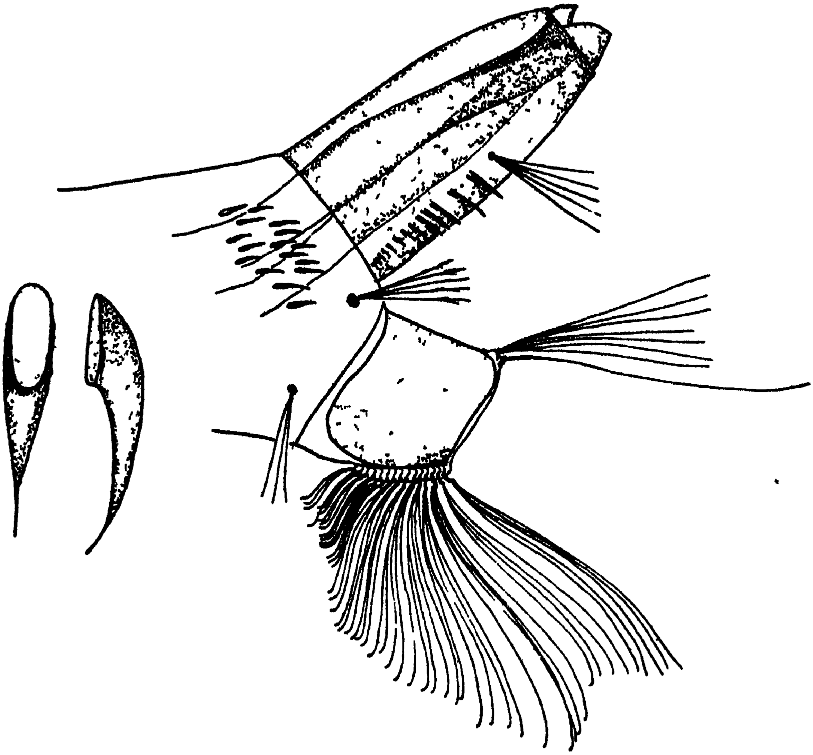

Fig 16. *Aedes ventrovittis* Dyar Caudal end of larva and enlarged comb scale

The larvae inhabit shallow, water-filled depressions in company with *hexodontus* and *palustris*. The Echo Lake collections mentioned under *hexodontus* contained a few females of this species. The location of Echo Lake is at approximately the same elevation as that given in Dyar's record for the breeding of this species at Summit and but a few miles distant. The specimens were worn and abraded, giving evidence of considerable flight or age. They may have emerged from the *hexodontus* pools in the immediate vicinity or may have traveled through the pass from Summit. During the first week in July in 1920, this species was the predominant mosquito in Yosemite National Park above the 8000-foot level. When first encountered, its members were limited to small mountain meadows typical for *tahoënsis*, with which they were associated. Here they occurred in such numbers that white horses literally became black with them, nor did they confine their biting to the horses. Members of the party, although liberally anointed with "bamber" oil were viciously bitten, thirty or forty mosquitoes sucking blood on the back of one hand at the same time. A few yards' travel into the surrounding forest area sufficed to avoid the great majority of this species at this time. Within a few days the meadow swarms were dispersed and no section of the high Sierra in this region was free from them, particularly at elevations above those where the swarms were first encountered.

During the last week in June of 1921 the writer made a trip to Fletcher Creek Meadows, one of the areas where the huge swarms had been met with later in the season of the previous year. These meadows are situated at the headwaters of Fletcher Creek at an elevation of approximately 10,000 feet, between the Lyell fork of the Tuolumne and the Merced in the Yosemite National Park. Snow was encountered at the 8000-foot level and soon after females of *ventrovittis* appeared, biting viciously and increasing in numbers until the meadows were reached, where they were as thick as on the preceding year. The meadows were entirely under snow which, in some places was from ten to fifteen feet deep. Along the bed of the creek the snow had melted in spots, leaving pools not more than three or four feet in diameter arched with great snow caverns. *Tahoinsis* larvae were present in these pools although no adults of this species were present but no *ventrovittis* imagines emerged from the catch nor were any but *tahoënsis* among the larvae that died before emergence. The vicinity of the pools was carefully swept as were the low-hanging boughs of the trees around the edges of the meadow but no males of *ventrovittis* were taken.

Dyar (1924*c*) reports the taking of a male at Fletcher Creek Meadows which proved to be identical with the male previously described as *Aëdes fisheri* Dyar. This forces the latter into synonymy and ends a long, hitherto fruitless search for the male and larva of this important Sierran mosquito. The dispersal flight, starting in the alpine meadows, is in all directions but more general and faster toward the higher elevations. The summit of Mt. Lyell—over 13,000 feet—is reached within two or three days after the dispersal flight from the 8900-foot level at its base, while fully three weeks is required for this species to reach Lake Merced at the 7000-foot level from the Fletcher Creek Meadows at 10,000 feet. These observations were checked by noting the progression daily in the case of Mt. Lyell and at intervals of two or three days in the case of Lake Merced.

The species ranges along the Sierra crest at high altitudes from Yosemite to Plumas County. Dyar has specimens from Mt. Rainier, Washington, which he has referred to this species although remarking that the diagnosis was doubtful on account of their poor condition.

Group **impiger**

This group is represented in California by three species, *Aëdes communis tahoënsis* Dyar, *Aëdes cataphylla* Dyar, and *Aëdes impiger* Walk. The members share with those of group *punctor* the designation of the "black-legged" *Aëdes* on account of the absence of tarsal white bands. The Nearctic species of the group separates into two series on the basis of the characters of the male terminalia: (1) the *communis* series with the apical lobe well clothed with setae; and (2) the *impiger* series with this lobe almost devoid of setae.

Aëdes (Ochlerotatus) communis tahoënsis Dyar

Culex communis DeGeer, Mem., tome 6, p. 316.
Aedes tahoensis Dyar, Ins. Ins. Mens., vol. 4, p. 82, 1916.

FEMALE. *Head.* Integument black. Occiput with narrow, curved, yellowish white scales on vertex, those at side flat and white, ocular bristles black, a clump of pale ones between eyes; erect, forked, yellowish scales at nape. Proboscis uniform with dark brown scales; clypeus brown, nude. Palpi with brown scales and a few white ones. Tori light on outer margin, darker within; antennae dark with "second" segment paler.

Thorax. Integument dark brown. Mesonotum with three whitish longitudinal areas of "bloom" extending forward from antescutellar space; vestiture of narrow, curved, golden scales with wider gray ones predominating laterally, two narrow longitudinal stripes of darker brown scales separated medianly by normal pale scales and sometimes with a subdorsal pair posteriorly. Scutellum light brown with sparse white scales and black bristles on lobes. Pleurae lighter with white scales. Legs black; femora white scaled below; knees white; tibiae with some white scales; tarsi unbanded; claws toothed, 1.1-1 1-1 1. Wing scales black. Length 4.5 mm.

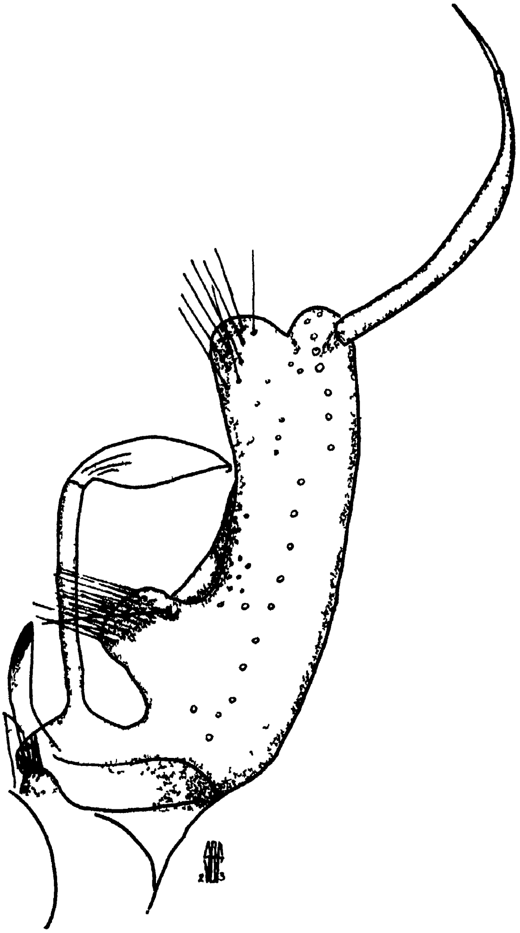

Fig. 17. *Aedes communis tahoensis* Dyar Male terminalia

Abdomen. Integument brown. Dorsal vestiture of black scales provided with basal, segmental, white bands slightly widened at sides; first segment with sparse white scales throughout. Ventral vestiture of white scales. Cerci black. Length of body 4.7 mm.

Male. Coloration as in female except that venter of abdomen has the basal halves of segments white.

Terminalia (fig. 17). Basistyles 3 × 1, columnar, with well developed lacunae and prominent apical lobes bearing a few normal setae; dististyles slender, slightly swollen centrally and with well developed terminal claws; basal lobes prominent, tips U-shaped with the open end of U apically directed; densely setose, a differentiated spine at upper, open end of U. Claspette shaft long and slender with its appendage about three-fourths as long as shaft; appendage expanded centrally on both sides and terminating in a sharp, sometimes recurved point, its base with two ridges. Entire length of claspette slightly longer than that of basistyle. Paraprocts slender, upright, and chitinized at tip. Phallosome conelike, inconspicuous. Lobes of ninth tergite with crests of short, stout spines.

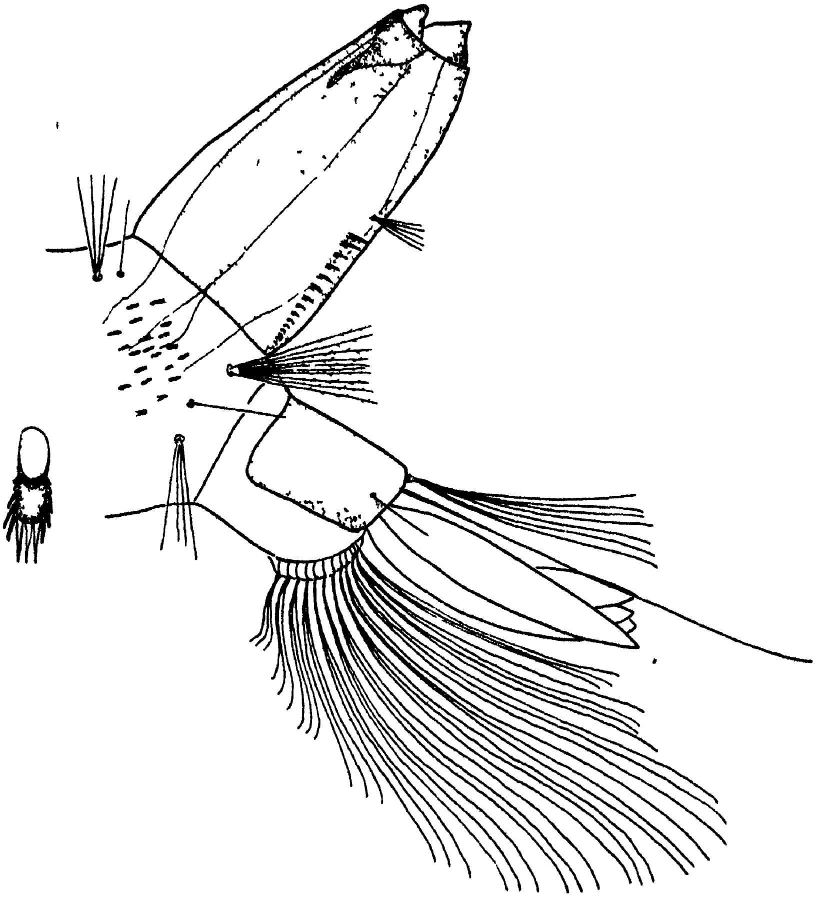

Fig. 18. *Aedes communis tahoensis* Dyar. Caudal end of larva and enlarged comb scale.

Larva (fig. 18). Air tube slightly more than twice as long as its width at base; pecten of eleven to fifteen evenly spaced teeth, each tooth with from two to five basal denticules, one being larger than the rest in each case; tuft of five hairs following the pecten at middle of tube; tracheal ampoules broad. Anal saddle not encircling segment and with a single hair posteriorly on each side. Dorsal brush a seven-haired tuft on each side; dorsal hair longer than brush; ventral brush profuse, well developed. Anal gills pointed, as long as dorsal brush. Comb scales of eighth segment sparse, each scale bluntly oval with a fringe of well developed thorns, those arising apically longest and stoutest but without any one differentiated thorn. Dorsal head hairs with upper ones double or in threes, lower ones single. Mental plate triangular, apex forming angle of 90 degrees, teeth subequal, those at outer angles stoutest. Antennae uniformly and slightly tapering, minutely spinose, those on inner margin arranged in longitudinal rows; a multiple hair tuft at the middle, apical armature of a short and long spine inserted very slightly before apex, and apically a short spine, a conelike pedicelated rod, and a palpus-like appendage chitinized at base but membranous at tip.

Aëdes communis tahoënsis Dyar is most commonly confused with *hexodontus,* a member of the *punctor* group. It is separated in the adult female by the gray lateral aspect of the mesonotum which is yellow in *hexodontus.* The pale dorsal bands of the abdomen are also apt to be much whiter than those of *hexodontus,* which tend to be cream colored. *Aëdes impiger* (Walk.) is practically inseparable in the adult female but as this species is only rarely encountered in California the confusion is not great. In the northern part of its range it becomes smaller and the markings are less distinctive. Race *masamae,* which occurs at Crater Lake, Oregon, has the gray of the mesonotum replaced by brown; and *altiusculus* at Mt. Rainier, Washington, has the mesonotum dark yellow with black markings. Race *borealis* from Alaska agrees more closely in markings with *tahoënsis* which, in turn, is closer to the parent *communis* stock than the other variations. The larvae separate from *cataphylla* by having the pecten teeth evenly spaced, and from *impiger,* its remaining ally in the *impiger* group, by having no differentiated apical spine on the comb scales. They are separated from *hexodontus* on the same basis. In brief, the larvae are characterized by having the teeth of the pecten evenly spaced, the comb scales of the eighth segment strong and well developed but without a differentiated apical spine, and the anal saddle not ringing the plate.

South of the Tahoe district, this mosquito shares with *Aëdes ventrovittis* Dyar the honor of being the most prevalent Sierran mosquito above the 5000-foot elevation. To sojourners in the high Sierra of the Yosemite section, *Aëdes communis tahoënsis* Dyar will be recalled with a shudder as "that big brown mosquito" and its ally *ventrovittis* as "the little black one." Its breeding place is normally the deep, clean-cut pools that dot the mountain meadows. These meadows are drained almost invariably by small streams that dry up in midsummer. Scattered on either side of the streams are pools with high, clean banks covered with short vegetation like *Bryanthus*. The pools are generally from six inches to a foot and a half in depth, cold, and often covered with ice nightly when they are first formed by the melting snow. Within a few days, however, they are hot to the hand at midday on account of the warming action of the sun at the late period of the year when they are freed from their coverings of snow (7000 feet in May, 8000 to 9000 feet in June to July at the latitude of Yosemite). Pools favorable for this species often occur at the heads of the small mountain lakes where inflowing streams are building up deltas or along the shores of permanent rivers where their downward rush is checked by an intervening level stretch. In such pools, if they are within its range, *tahoënsis* invariably occurs. Although one of the earliest species on the wing, it is also one of the latest. The character of its breeding pools makes for a degree of permanence that species inhabiting shallow seepage pools do not enjoy. Owing to this factor, the species has adapted itself to a leisurely progress of egg-hatching. *Tahoënsis* pools, on account of their depth and sheltering banks, sometimes persist for several weeks and continue to harbor larvae until nearly dried. The progressive hatching of the eggs proceeds from the time that water is first present, even though half the pool may be under snow and ice and the remainder frozen over nightly, to the time when the pool is nearly ready to dry up in midsummer. The drying up process is, of course, accompanied by an increase in the temperature of the water which, in turn, accelerates the growth of the straggling larvae and prevents, to some extent, the destruction of these late forms. The synchronization is not perfect, however, and many larvae perish as the result of late hatching or the premature drying of the pools. It is interesting to note in this connection that Martini (1920) found below the surface of dry leaves that formed the bottom of a dried-up breeding pool of this species a layer of moist leaves between which were such an "Unmengen von *Nemorosus*—(=*communis*) Larven und Pupen, so dass man Eindruck hatte, die Entwicklung ganz grosser Larven gehe fast ungestort weiter." The writer has seen many drying pools containing this species in the Sierra but has never observed any survival as depicted by Martini. Stranded pupae will give rise to imagines in a large percentage of cases even though the former are moored fast in the mud at the bottom but the larvae invariably perish, sometimes in such numbers as to make a glistening floor to the pool. Even if such survival was accomplished temporarily, the drying in the Sierra is too complete and of such long duration that the holding over would be impossible. It is possible that larvae imprisoned in the moist, leafy layers could live for some time and in rainy areas might survive until the pool was refilled by a shower. Wesenburg-Lund (1920) reports this species as the commonest black-legged forest mosquito of northern and central Europe. He records the hatching of the overwintering eggs and the presence of first-stage larvae as early as January in Denmark on the margins of frozen pools where the temperature on warm days rises to 10° C. at times. These larvae do not grow at this temperature and are overtaken by the main brood which hatches in April. He also reports the simultaneous emergence of all members of the species in a given pool, which is somewhat different from our findings in the Sierra. The breeding places of the Danish race evidently differ, as his descriptions and figures locate *communis* breeding in rather shallow, shaded pools whereas the most typical Sierra pools are in the open and deep. The difference in the emergence habits may be on account of the differences in the advent of spring. In Denmark the advent is slow and gradual, thus allowing all the eggs to be hatched yet holding all the larvae in the first stage, giving them all an even start. In the Sierra, spring blossoms in a day—one day the meadows are snowbound and wintery and then, almost within twenty-four hours, the snow banks are dotted with pools, the buds swell, and the snow line recedes. The variability in the hatching of the eggs starts from that point and those first hatched immediately begin growth on account of the warming action of the sun already high on its course. This gives the early hatched larvae a decided start over the later ones. The average time for the development period is twelve to fourteen days although, in cases such as Wesenburg-Lund has shown of premature hatching, the cycle may be lengthened to four months.

The adult *communis* females are apparently long-lived. It is difficult to state this positively as the delayed emergence at higher altitudes provides a supply for the lower levels which may be mistaken for the original habitants of that lower level. At the upper limits of breeding (9000 feet) where this complication is not experienced, the females are present in constantly diminishing members for approximately two months. The males, true to the general precepts of mosquito life, live but a few days after emergence, mating taking place shortly after the emergence of the females. The dispersion of the females, which is a form of migratory flight, tends to be toward the lower elevations in contradistinction to its ally, *Aëdes ventrovittis* Dyar, which spreads to the higher altitudes.

In the numerous larval collections made by the writer and in those submitted to him by the Public Health Service and the National Park Service for identification from Yosemite Valley proper, *communis* larvae have not been present although their adults are constant visitors, particularly late in the season after *Aëdes increpitus* Dyar, the predominant Valley breeder, has almost disappeared. This is to be explained by the downward migration trend of the adult females.

The eggs, which are deposited singly in small lots of from four to ten, are placed in the beds of the dried-up pools or along the edges of receding pools. They are typical *Aëdes* eggs, fusiform, reticulated, with one end more pointed than the other, and with one side slightly flattened. They are heavier than water and may be separated from the bottom débris by sedimentation.

Aëdes (Ochlerotatus) cataphylla Dyar

Aëdes cataphylla Dyar, Ins. Ins. Mens., vol. 4, p. 86, 1916.
Aëdes prodotes Dyar, Ins. Ins. Mens., vol 5, p. 118, 1917.
Aedes cataphylla Dyar, Ins. Ins. Mens., vol. 8, p. 67, 1920.
Aëdes rostochiensis Martini, Sitzb. u. Abh. Natfor. Gesell. Rostock, vol. 7, p. 204, 1920.
Aedes cataphylla var. *rostochiensis* Edwards, Bull. Entom. Research, vol. 12, p. 310, 1921.

FEMALE. *Head.* Integument black; occiput densely clothed with narrow, curved, white and yellow scales, a patch of dark brown ones laterally and flat white ones on the side; bristles along eye margins black, others pale; erect, forked white and black scales at nape. Tori brown, with patch of white scales within; antennae black, "second" segment with pure white scales. Palpi black scaled, flecked with white. Proboscis uniform, brown with many white scales basally.

Thorax. Mesonotum dark brown with golden brown scales, lateral and anterior margins of the antescutellar space may or may not be joined to lateral gray margin by oblique stripe of white scales. Scutellum lighter with pale white scales and brownish black bristles. Pleurae brownish gray with white scales and pale bristles; coxae the same; femora brown with white scales predominant; tibiae with more dark scales; first tarsal segment with white scales basally, remainder of tarsi brown. Claws toothed 1.1-1.1-1.1. Halteres white scaled. Wings black scaled with many white ones along costa and first and second longitudinal veins.

Abdomen. Dorsal vestiture of dark brown scales with broad basal white bands; first segment entirely clothed with white scales and pale bristles. Ventral vestiture of white scales with median, triangular, basal, black markings and subapical, sublateral, black spots. Cerci black.

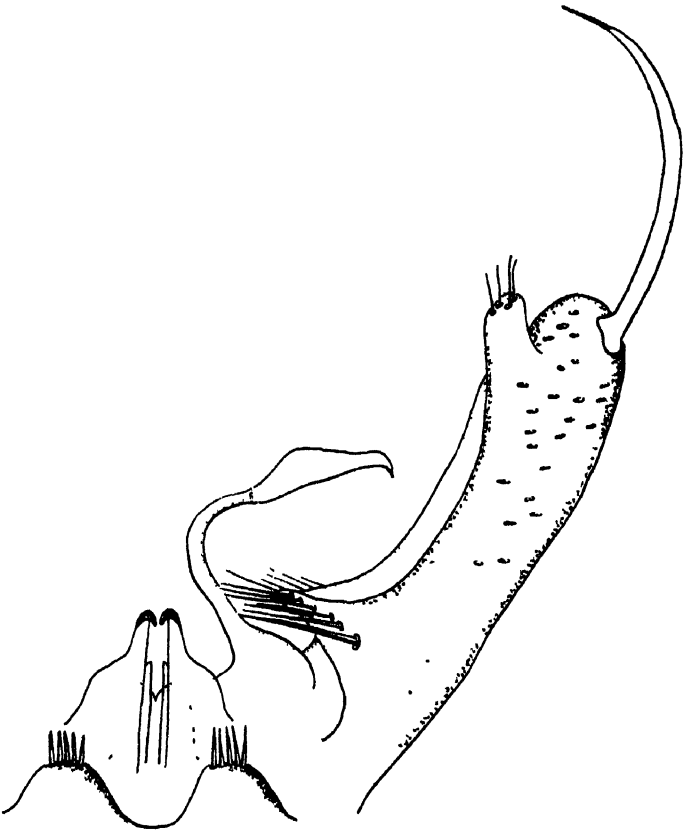

Fig. 19. *Aedes cataphylla* Dyar. Male terminalia.

Male. Coloration as in female except that it has a broad, median, black stripe ventrally on abdomen, and the long segments of palpi have broad white bands, last two segments also with some white basally. Whole body densely hairy, particularly last segments of palpi and the terminalia.

Terminalia (fig. 19). Basistyles columnar, about three times as long as wide; dististyles decidedly slender with terminal claws; apical lobes well developed with a few weak setae; basal lobes prominent, setose, a single basal spine present on outer margin. Claspette with long arched shaft, minutely setose, appendage pointed and expanded on one side at point basad of middle. Paraprocts triangular, recurved and chitinous at tip. Phallosome inconspicuous, cone-shaped. Lobes of ninth tergite prominent with a terminal clump of stout spines.

Larva (fig. 20). Air tube a little over two and one-half times as long as width at its base, expanding to hair tuft and then tapering uniformly to tip; tracheal ampoules moderately broad; pecten with from twelve to fifteen evenly spaced teeth, and three detached ones beyond the two-haired tuft, those of evenly spaced portion with single basal denticule, detached ones longer, curved, and untoothed. Anal saddle not ringing segment, incised for reception of plate of ventral brush, anterior portion extending farther ventrally than posterior portion, a single hair posteriorly. Dorsal brush, a pair of seven-haired tufts, moderate in length; dorsal hairs well developed, ventral brush well developed and preceded by one or two small hair tufts anterior to plate. Comb scales of eighth segment arranged in two irregular rows, ten to twelve in number, each scale consisting of a long central thorn fringed basally by a few smaller ones. Dorsal head hairs both single. Mental plate triangular, apex forming angle of slightly more than 90 degrees. Antennae cylindrical, tapering very little, dark brown, minutely spinose in rows inwardly, more heavily and sparsely spined outwardly; hair tuft of four hairs at middle; apical armature without subapical insertions and consisting of two short and one long setae, a conelike pedicelated rod, and a palpus-like digit, chitinous at base and membranous at tip.

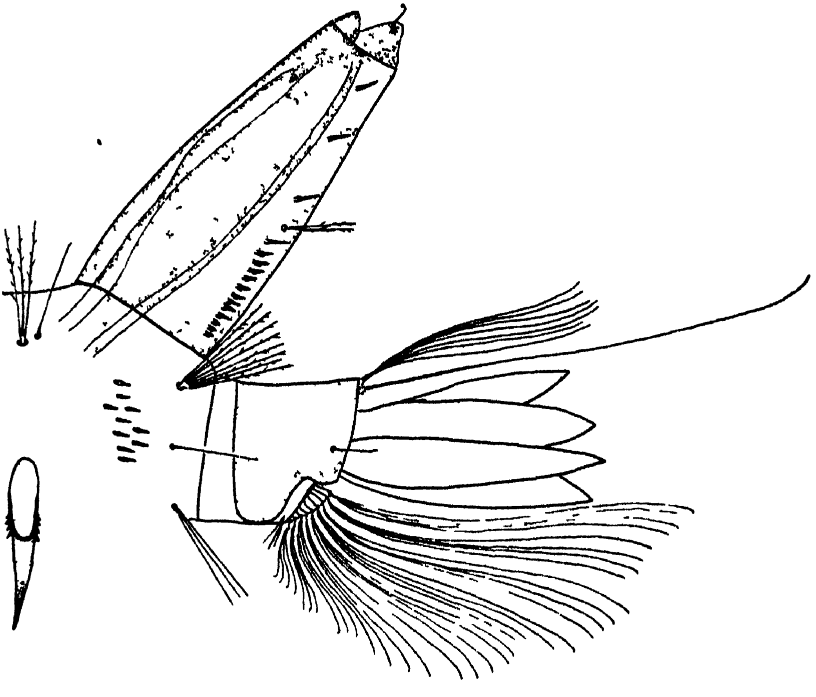

Fig 20. *Aedes cataphylla* Dyar. Caudal end of larva and enlarged comb scale.

Cataphylla in its normal form is easily separated from its Californian allies in the *impiger* group by its lack of mesonotal stripes. There is often, however, a suggestion of a pair of dark brown median lines, extending anteriorly from the antescutellar space but becoming diffused before the anterior margin is reached. The basal white markings of the long joint of the male palpus is characteristic. It separates, in its aberrant form, from *increpitus* by the absence of tarsal white rings; from *tahoënsis* by its lack of mesonotal stripes and the gray lateral markings of the mesonotum of *tahoënsis.* It is preeminently a medium-sized mosquito smaller than the normal *tahoënsis* or *hexodontus.* In general coloration it is a grayish brown, the gray color so predominating that it seems to have been dusted with flour. Even the wings partake of this dusty appearance. The larvae are unique in the arrangement of the detached spines of the pecten. These detached spines vary in number from two to four (sometimes between the two sides of the air tube) but the normal number is three. Where four are present the basal one commonly occurs between the pecten proper and the hair tuft, the apical one, however, always occurs near the apex of the tube whatever the number.

This species, *cataphylla,* was originally described by Dyar for a distinct group of Sierran mosquitoes geographically separated from the later described *Aedes prodotes* Dyar, with its range in the Canadian Rockies to Alaska. Martini described a similar mosquito from northern and central Europe as *Aëdes rostochiensis* Martini, which Edwards (1921) reduced to the status of a race of *cataphylla.* Dyar has shown *prodotes* to be synonymous with *cataphylla.* The combination of these forms extends the range, therefore, from an isolated group of the mid-Sierra to include the northern Rockies from Montana to Alaska and northern and central Europe. In California, the species occurs infrequently in the Yosemite section at high altitudes and evidently has its center in the Tahoe area. To the north of Tahoe it is apparently absent. The species is an early one, appearing on the wing before all the other mosquitoes except *ventrovittis.* Its larvae are facultative, breeding in grassy meadow pools, in deep snow pools, in open, sunny meadows, or in forest pools. The adults bite viciously despite statements to the contrary, attacking horses and men in broad noonday.

Aëdes (Ochlerotatus) impiger (Walker)

Culex impiger Walker, List. Dipt. Brit. Mus., vol. 1, p. 6, 1848.
Aedes decticus Howard, Dyar, and Knab, Mos. No. and Centr. Am. and W. I., vol. 4, p. 737, 1917.

FEMALE. *Head.* Integument black. Occiput with narrow, median line of narrow, curved, white scales, lateral ones flat and yellowish surrounding two black spots of flat scales or a single black spot flecked with white scales; ocular bristles black; nape with upright, forked, black scales and narrow, curved yellow ones. Tori dark; antennae black. Palpi one-fifth the length of proboscis, metallic black; clypeus black, nude. Proboscis uniform, slender, black.

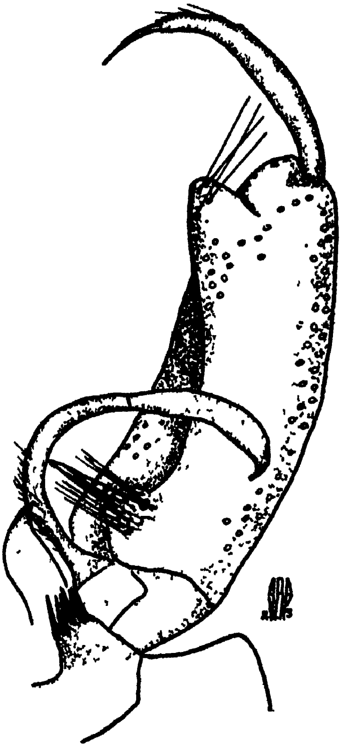

Fig. 21. *Aëdes impiger* (Walk.). Male terminalia.

Thorax. Mesonotum black; vestiture of narrow, curved scales, those of anterior and lateral margins and antescutellar space gray, dark brown ones forming a central stripe divided in middle by a fine line of yellowish scales. Subdorsal dark stripes project forward from either side of the antescutellar space to the middle. Scutellum trilobate, black with pale scales and bristles. Pleurae black, coxae paler with white scales; femora dark, metallic brown, whitish beneath nearly to tips; tibiae and tarsi metallic brown; claws toothed 1.1-1.1-1.1. Wing scales dark brown. Length of wing 3.8 mm. Halteres whitish.

Abdomen. Dorsal vestiture of dead black scales, lateral patches of white ones basally on the segments or with a complete basal band; the first segment almost wholly white scaled. Venter black with yellowish white basal bands, becoming narrower distally. Cerci black. Length of body 3.8–4.0 mm.

MALE. Coloration like that of female. Length of wing 3.8 mm.; body 4.0 mm.

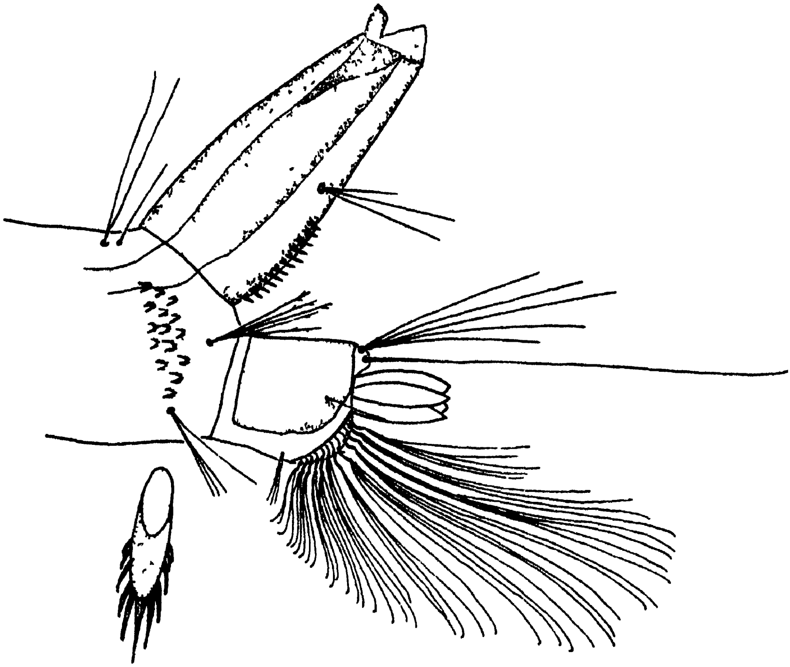

Fig. 22. *Aedes impiger* (Walk.). Caudal end of larva and enlarged comb scale.

Terminalia (fig. 21). Basistyles columnar, about three times as long as their width at base; dististyles slender with apical claws; both basal and apical lobes well developed, the latter weakly clothed with outwardly directed hairs, the former prominent, well clothed with setae and bearing one differentiated spine at apical margin of setose area. Claspette with its appendage as long as basistyle, appendage lanceolate, symmetrical, and more than one-half as long as its shaft.

LARVA (fig. 22). Air tube about two and one-half times as long as its width at base; tracheal ampoules moderate; pecten of from twelve to seventeen evenly spaced teeth, each tooth with one large basal denticule and one to three smaller ones; a three-haired tuft at middle of tube. Comb scales of eighth segment fifteen to twenty in number, each scale with a stout central spine flanked by two of

nearly equal size and a fringe of progressively smaller ones basally. Anal saddle broad, ventral edges thin and irregular but not ringing segment, a single hair posteriorly. Dorsal and ventral brushes complete but moderate in length. Anal gills short and lanceolate. One or two hair tufts anterior to plate of ventral brush. Antennae minutely spinose in irregular rows inwardly; with coarser, stouter spines outwardly; hair tuft of two or three long hairs at middle of antennal shaft; apical armature of one long and two short setae, a conelike, pedicelated rod, and a palpus-like appendage chitinous at base and membranous at tip.

The species under consideration has had a varied taxonomic career. It was treated in Howard, Dyar, and Knab's monograph as *decticus*, a new species of which the male and larva were unknown, the *impiger* of that work applying to *Aëdes intrudens* Dyar. We here treat of *Aëdes impiger* Walker (sense of *decticus*). This species has never been taken in California by the writer and until Dyar found it in the Tahoe region its occurrence in this State had never been reported. The only Californian reference is that stated, where it was found "true to its habits in the Yukon territory . . . . associated with *Aëdes cataphylla* Dyar (*prodotes* Dyar) in lesser numbers, occurring in two large breeding-places discovered to the extent of about 10 per cent of the number.

"Little Truckee River, California, May 7, 8, 9, 1921 (H. G. Dyar).

"Lake Tahoe, California, May 7 to 12, 1921 (H. G. Dyar)."'

Dyar (1922) lists the previously recognized range as "throughout Canada to Alaska and in northern New England, New York, Minnesota and Montana . . . . The larvae occur in small forest pools, resembling those of *lazarensis* [*communis*]. The species is never abundant."

The adult female is indistinguishable from *tahoënsis* except that it is generally smaller than the smallest forms of the latter. Its larvae are separable from *tahoënsis* by the differentiated apical spine of its comb scales.

Group **stimulans**

This group may be characterized as the only Holarctic group of the subgenus *Ochlerotatus*, which has the tarsi white banded at the base only. This character is one of expediency as it is repeated by other groups of the same subgenus in Australia and by other subgenera of *Aëdes*.

The Nearctic members of the group are divided into three series on the basis of the male terminalia: (1) *excrucians* series with the basal lobe flat and the spine or tuft of setae wanting; (2) the *stimulans* series with the basal lobe flat with a strong spine; and (3) the *fitchi* series with the basal lobe conical and a strong or weak spine.

This group is of particular interest in that it marks a southern extension of a typically northern group and the adaptation of two of its members—*squamiger* and *cantator*—to a salt marsh environment. The *excrucians* series is represented in California by *increpitus*, and the *fitchi* series by *fitchi palustris* and *squamiger*. The *stimulans* series is unrepresented thus far, although it seems probable that an *aloponotum*-like modification of *flavescens* must be present in the Cascades or the Sierra crest.

A single species of this group, *flavescens*, is Holarctic, which is particularly interesting in connection with the progressive southern invasion of this group and suggestive of a longer separation from the Palearctic fauna than that of groups *punctor*, *impiger*, or *dorsalis*. This is still further emphasized by the findings of Edwards (1921) who believes that the American *flavescens* (=*fletcheri* Coq.) is distinct from the European *flavescens*, which he prefers to call *Aedes lutescens* Fabr.

Aëdes (Ochlerotatus) increpitus Dyar

Aedes increpitus Dyar, Ins. Ins. Mens., vol. 4, p. 87, 1916.

FEMALE. *Head.* Integument black; occiput with narrow, curved. brown scales on vertex, flat, white ones laterally; ocular bristles black, the others pale; erect, forked scales dark in dark areas and pale in light areas. Tori brown with a patch of light scales inwardly; antennae dark, the "second" segment pale at base; palpi short, black with yellowish scales at bases and apices of segments; proboscis uniform, dark brown with a few pale scales.

Thorax. Mesonotum dark brown with vestiture of grayish to straw-colored scales; a pair of dorsal and subdorsal stripes of brown, narrow, curved scales; scales of antescutellar space pale. Scutellum paler with pale scales and black bristles. Pleurae light brown with brown and white scales, the brown predominating anteriorly. Coxae light brown with pale scales; femora yellow scaled below, mixed with black and white above; knees narrowly white; tibiae with black and white scales, the black ones predominating toward tip; tarsi of forelegs black with narrow bands on the first three segments, the last two wholly black; mid-tarsi with a broad white ring basally on all segments. Claw formula 1.1-1.1-1.1. Halteres pale. Wing scales black with some white scales on costal vein and first longitudinal. Length of wing 4.5 mm.

Abdomen. Dorsal vestiture of black scales with broad, white, basal bands widening to form lateral, triangular patches progressively longer caudad until they extend entire length of penultimate segment. Last segment entirely black. Ventral vestiture of white scales with distinct, basal median, and supapical, lateral spots of black scales. Cerci black. Length of body 5 mm.

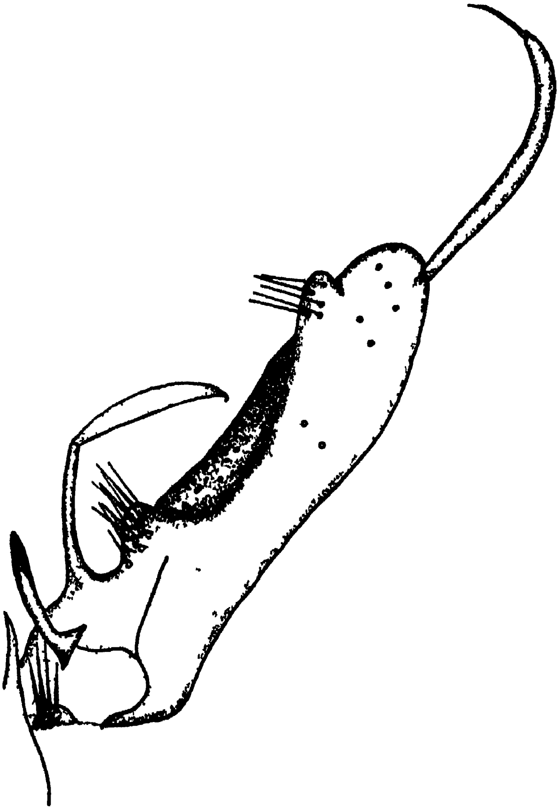

Fig. 23. *Aedes increpitus* Dyar. Male terminalia.

Male. Coloration similar except that dorsal abdominal bands more suffused and uniform in width; venter sparsely scaled with white, rendering the black markings less distinct. Palpi exceed proboscis by length of last segment; long segment bears white scales forming ring in middle. Length of body 5 mm.; wing 4 mm. Claw formula 1 1-1.1-1.1.

Terminalia (fig. 23). Basistyles two and one-half times as long as wide; dististyles slender, very slightly expanded medially and with terminal claws; apical lobes small but definite with a few short setae; basal lobes flattened, densely and uniformly setose without differentiated spine. Claspette with a slender shaft, appendage more than one-half as long as shaft and expanded uniformly on both sides in middle and terminated in a point. Paraprocts narrow, upright, pointed and chitinous at tip. Phallosome inconspicuous, pointed, conelike. Lobes of ninth tergite prominent with a terminal cluster of stout spines.

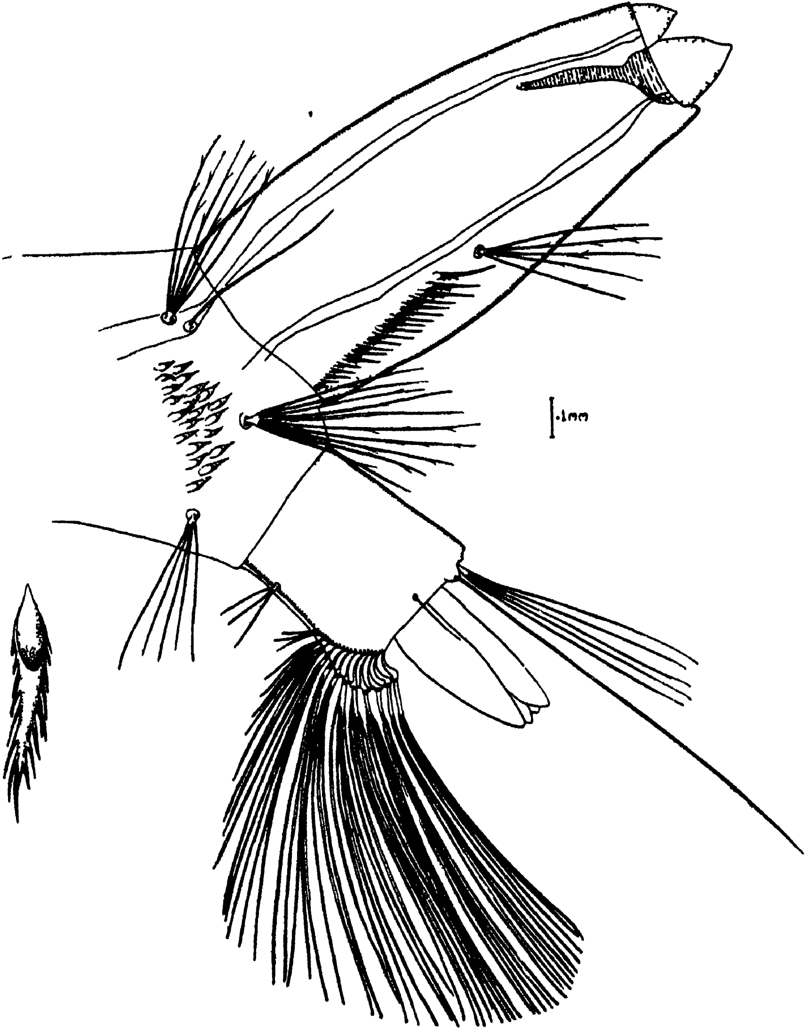

Fig. 24. *Aedes increpitus* Dyar. Caudal end of larva and enlarged comb scale.

LARVA (fig. 24). Air tube slightly more than two and one-half times as long as its width at base expanding to insertion of hair tuft, then tapering to apex; tracheal ampoules moderate; pecten of eighteen to twenty evenly spaced teeth, each tooth with one large and from none to four smaller denticules basally; hair tuft of air tube midway of tube and composed of from three to seven hairs. Anal saddle covering sides of segment but not meeting ventrally; a single hair posteroventrally. Dorsal and ventral brushes moderate. Anal gills short and pointed. Comb scales of eighth segment numerous (30–50), each scale with a stout apical spine flanked by slightly shorter ones, the other becoming progressively smaller basally. Mental plate triangular, apex forming angle of 90 degrees, teeth subequal, those at lateral angles stoutest. Dorsal head hairs with upper pair double or multiple, lower pair single or double. Antennae uniformly tapered, darker at apex, minutely spined inwardly at base and sparsely spined with larger spines outwardly and inwardly at apex; multiple hair tuft slightly before middle; apical armature of a short and a long seta, a conelike, pedicelated rod, and a palpus-like appendage, chitinous at base and membranous apically.

Vestiture of occiput variable as is banding of tarsal segments. Minute white rings sometimes present on segments described as normally all black.

The presence of basal, tarsal white bands limits the number of Californian species with which this mosquito might be confused. Its presence along the coast range might cause its confusion with the small forms of two basally banded salt marsh breeders, *Aëdes taeniorhyncus* (Wied.) and *Aëdes squamiger* (Coq.). The former is readily separated by its white-banded proboscis and the latter by its swollen wing scales. *Aëdes vexans* (Meigen), which sometimes reaches the Sierra breeding grounds of *increpitus* as well as those in the coast range, may be separated by its larger size and its very narrow tarsal rings. Its closest ally, *fitchi palustris,* can generally be separated by the presence of numerous white scales on all the veins of the wing whereas the white scales of *increpitus* are limited largely to the costal and first longitudinal in most cases. The larva with its typical open pool type of short, stout air tube is easily separated from the long-tubed larva of *palustris.* It most closely resembles the larva of *impiger* from which it is separated by its dorsal head hairs, the upper pair occurring in multiple tufts, generally of four hairs but sometimes of only two, while *impiger* has these hairs single.

This mosquito was the predominant mosquito of Yosemite Valley, where it found a typical breeding place in the pools left by the Merced after the earily spring floods until the thoroughness of anti-mosquito work rendered it a rare species in that locality. It is typically an inhabitant of the meadow areas of the large river valleys and the pools bordering lakes. Its larvae appeared in Yosemite during March and were full-grown by the middle of April. In normal years, they generally reached their peak in this location by April 25. At Tahoe, they are later, for there is a difference of nearly two thousand feet in altitude and a degree of latitude, which delay their appearance for nearly two months. The tendency of the entire group *stimulans* toward a southerly extension is illustrated in this species which although penetrating to the Sierra, is confined to the valleys and in general to the lower latitudes. The writer has never taken even the migrating adults above seven thousand feet. Its aptitude for the lower levels has carried it through the Cascades and into the coast range of California down to actual sea level (Pacific Grove, California. I. McCracken, 2-vii-'03) where it comes in contact with its closely related, though normally distinct geographically, ally *Aëdes squamiger* (Coq.).

With its race *mutatus*, the range of the species is the Rockies from British Columbia to New Mexico, the Cascades, coast range, and Sierra crest of California.

Aëdes (Ochlerotatus) fitchi palustris Dyar

Culex fitchi Felt and Young, Science, n.s., vol. 20, p. 312, 1904.
Aëdes palustris Dyar, Ins. Ins. Mens., vol. 4, p. 89, 1916.
Aedes palustris v. *pricei* Dyar, Ins. Ins. Mens., vol. 5, p. 16, 1917.

FEMALE. *Head.* Integument black. Occiput with brown narrow, curved scales on vertex, those on sides flat and yellowish white; ocular bristles black, the others pale; erect, forked scales of white, black, and brown. Tori brown with patch of white scales inwardly; antennae dark, the "second" segment pale at base. Palpi black with some yellowish scales at bases and apices of segments. Proboscis uniformly dark with some pale scales.

Thorax. Mesonotum dark brown with vestiture of yellowish scales, those of lateral and anterior margins grayish; two dorsal stripes of dark brown anteriorly and two posterior, lateral stripes of the same scales; antescutellar space with pale scales. Pleurae light brown with pale yellow scales and pale bristles, anterior scales brownish. Coxae light brown with pale scales; femora yellow-scaled below mixed with black scales above; knees white; tibiae with black and white scales, black ones predominating distally; hind tarsi with broad white rings at bases of segments, those of fore- and mid-legs with first two and three segments, respectively, ringed. Claws toothed, -1.1-1.1-1.1. Halteres white. Wing scales black with many white ones intermixed, the white ones occurring principally on the first five veins but not limited to them. Length of wing 4.5 mm.

Abdomen. Black scaled dorsally with broad, white, basal bands, a few white scales on apical border and some intermixed among central black scales. Ventral vestiture of white scales with a black median stripe and black apical border, the latter sometimes reduced to black, apical, sublateral spots. Cerci black. Body length 5 mm.

MALE. Coloration similar to female. Palpi exceed the proboscis by length of last segment; long segment of palpus with a white central ring. Length of body 5 mm.; wing 4 mm. Claws toothed, -1.1-1.1-1.1.

Terminalia (fig. 25). Basistyles columnar, about three times as long as width at base; dististyles slightly expanded apically; apical lobes with a few normal setae directed inwardly; basal lobes large, rugose, elevated, with many setae, a single stout spine on upper margin of rugose area. Claspette short, scarcely one-half the length of basistyle; appendage short, sickle-shaped. Paraprocts short, inconspicuous, cone-shaped. Lobes of ninth tergite with long slender spines.

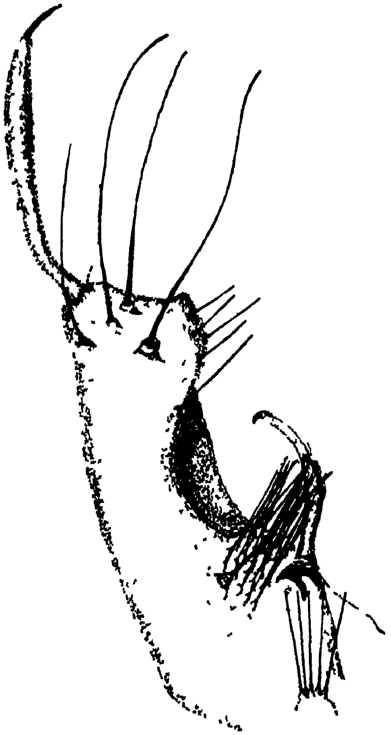

Fig. 25. *Aedes fitchi palustris* Dyar. Male terminalia.

LARVA (fig. 26). Air tube long, four times its width at base, evenly tapered from base to apex; tracheal ampoules moderate; pecten of seventeen to nineteen evenly spaced long teeth, each tooth with one large basal denticule and one or two smaller ones; hair tuft generally six-haired midway of tube. Anal saddle covering sides of segment but not meeting ventrally, a single hair tuft posteriorly; dorsal and ventral brushes moderate, anal gills moderate, about length of plate, and pointed. Comb scales of eighth segment in a triangular patch of about twenty scales, each scale with a stout apical spine, lateral ones decidedly smaller but not reduced to a minute basal fringe. Mental plate triangular, apex forming an angle of slightly less than 90 degrees, teeth at lateral margins decidedly stouter and more widely separated than those at apex. Dorsal hairs have upper pair in threes or fours, lower pair in twos or threes. Antennae slightly tapered and curved inwardly, sparsely spined with moderate spines irregularly placed; a multiple hair tuft of branching hairs midway of the shaft; apical armature without subapical insertions, consisting of two short setae and one long one, a conelike, pedicelated rod, and a palpus-like appendage, membranous at tip and chitinous at base.

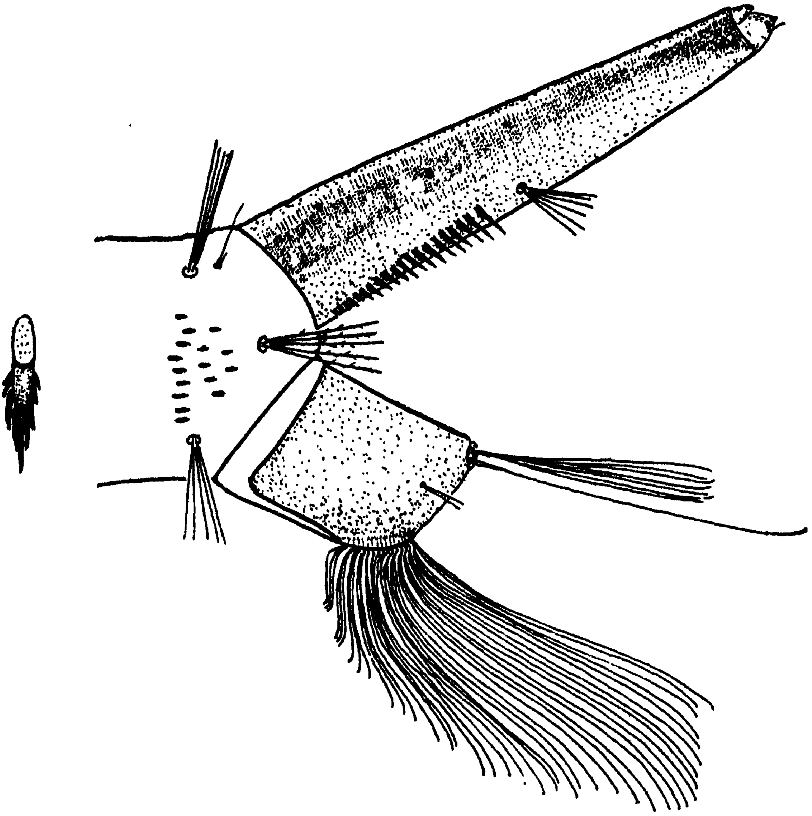

Fig. 26. *Aëdes fitchi palustris* Dyar. Caudal end of larva and enlarged comb scale.

The species is extremely variable in the markings of the abdomen and the banding of the legs. One form, which has been described as a variety (*pricei*), has a dorsal white stripe extending the length of the abdomen. Other specimens have the apical white scales absent and the basal bands reduced or broken in the middle. The banding of the fore-and mid-tarsi varies considerably and little taxonomic importance can be assigned to it, but that of the hind tarsi is relatively stable, varying only in the number of white scales appearing on the last segment. The larval characters vary slightly, particularly in the number of hairs in the upper and lower tufts and the relative length of the air tube. The race *palustris* differs from the normal *fitchi* in having the spines of the lobes of the ninth tergite longer and the spine of the basal lobe weaker. The differences are bridged and the variants united by the Rocky Mountain race, *mimesis*.

The basal white banding of its hind legs serves to differentiate it from any other species of *Aëdes* that are found within its range except *vexans* and *increpitus*. The former is separated by the narrow banding of its hind tarsi, and *increpitus* has the white wing scales largely limited to the costal area. *Palustris* has about one-third of the wing scales white and well distributed over the wing surface. The larvae are easily differentiated by their evenly spaced pecten and the long, uniformly tapered tube.

The larvae breed with *hexodontus* in shallow, grassy pools. The adults fly with *increpitus* if river or lake pools are available for the breeding of the latter. It frequents higher altitudes than *increpitus*, however, occurring up to 9000 feet in the Sierra crest east of Tuolumne Meadows in the Yosemite National Park, where its emergence is delayed until well into July. This habit is borne out by its northerly occurrence in the coastal area as far north as Alaska, while *increpitus*, including its race *mutatus*, has its northerly limit in British Columbia. The adults fly late in the season after all possible breeding pools have disappeared. They occur in the edges of the forested areas surrounding the grassy mountain meadows and bite viciously both day and evening. On bright moonlight nights they continue their feeding throughout the night but ordinarily become quiet as soon as it is dark. The eggs are laid singly in batches of four to ten on the mud at the edge of receding grassy pools or in the crevices of the sun-cracked earth in the beds of previous pools.

The race *palustris* ranges from the Sierra crest of California north to Crater Lake, Oregon, Washington, and along the coast to Alaska, and, by adding the range of the races *mimesis* and *fitchi fitchi*, the extent of the species reaches from the Pacific to the Atlantic in Canada extending into the United States in Washington, Oregon, and California (*palustris*), in Montana (*mimesis*), and in Wisconsin, New York, and New England (*fitchi*).

Aëdes (Ochlerotatus) squamiger (Coquillett)

Culex squamiger Coquillett, Proc. U. S. Nat. Mus., vol. 25, p. 85, 1902.
Grabhamia de niedmani Ludlow, Canad. Entom., vol. 36, p. 234, 1904.

FEMALE. *Head.* Integument black; occiput with broad, curved scales at vertex grayish in median line, brownish at sides and flanked with flat white ones; erect, forked scales black; ocular bristles black, a clump of pale ones between eyes. Tori light brown without, darker within, with a patch of light scales; antennae black. Palpi short, black with a few yellow scales. Proboscis uniformly black scaled with an admixture of pale ones centrally and particularly below, which may be mistaken for a band.

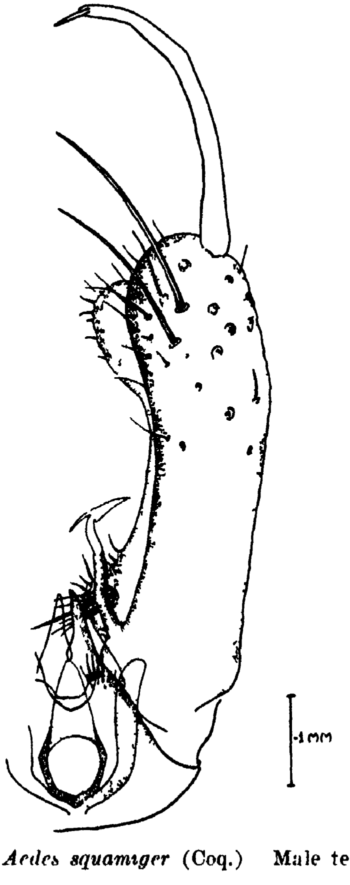

Fig. 27. *Aedes squamiger* (Coq.) Male terminalia.

Thorax. Mesonotum black; vestiture of pale brown scales with a border and two indistinct median stripes of pale straw-colored scales. Scutellum grayish brown with white scales and black bristles. Coxae paler; femora black and white scaled, black ones predominating above, white ones below; knees white; tibiae black and white scaled; tarsi with first segment flecked with white scales, the rest black scaled with basal bands of white except last two segments of the fore- and last segment of mid-tarsi which are wholly black, rings of hind tarsi wider than others. Claws toothed, -1.1-1.1-1.1. Wing scales broad and swollen, of equal numbers of black and white scales. Length of wing 5 mm. Halteres pale, tips darker with white scales.

Abdomen. Dorsal vestiture of black scales flecked with grayish yellow ones, a broad basal band of yellowish white scales on each segment, triangularly expanded in middle and interrupted sublaterally forming a row of lateral white spots. Ventral vestiture of white scales with subapical, sublateral black spots. Cerci black. Body length 5.5 mm.

MALE. Coloration similar to the female except basal abdominal bands wider; distal segments almost wholly white scaled. Palpi slightly longer than proboscis with long segment white banded in middle and with other nearly complete white bands both apically and basally, last two segments white scaled at bases. Claws toothed, 1.1-1.1-1.1. Body length 6.8 mm.; wing length 5 mm.

Terminalia (fig. 27). Basistyles about three times as long as width at base; dististyles slightly swollen centrally with apically inserted claws; apical lobes prominent with a few setae; basal lobes moderate, densely setose with differentiated spine arising in a clump of setae at dorsal, basal margins of lobes. Claspette slender, with its appendage a little more than half as long as basistyle, its shaft minutely spinose with two setae inwardly directed at base; appendage narrower at its base than shaft and continuing so to outer third where one side is triangularly produced to a point that is slightly recurved and then tapers rapidly to apex. Paraprocts prominent, upright, points heavily chitinized and recurved. Phallosome conical, inconspicuous. Lobes of ninth tergite with long spines.

LARVA (see fig. 13). Air tube less than twice as long as its width at base, slightly tapered at both ends; tracheal ampoules moderate, pecten of seventeen evenly spaced teeth, each tooth with two to four basal denticules; a multiple hair tuft at or just beyond middle. Anal saddle covering sides of segment, a single hair posteriorly. Dorsal and ventral brushs moderate; anal gills small and globular. Comb scales of eighth segment in triangular patch of from twenty-five to thirty scales, each scale with an even, though apically pointed fringe of stout thorns, many of them furcate and all arising from a common membrane. Mental plate triangular, apical angle making angle of less than 90 degrees, lateral teeth stoutest and most widely separated although extreme lateral one smaller. Dorsal head hairs with upper pair in twos, lower pair single. Antennae slightly swollen at base, then tapered to apex, shaft sparsely spinose, a multiple hair tuft at the middle; apical armature without subapical insertions and consisting of two short setae and one long one, a conelike, pedicelated rod, and a palpus-like appendage, chitinous at base and membranous apically.

Squamiger is closely related to the Eastern fresh-water breeder, *Aëdes grossbecki* Dyar and Knab, but differs in having the typical short air tube of a salt marsh breeder, that of *grossbecki* being long. The male terminalia differ in that the appendage of the claspette in *squamiger* is angularly produced and long whereas that of *grossbecki* is short and smoothly widened. It may be separated from its cobreeder in the south, *Aëdes taeniorhyncus* (Wied.), which also has basally white-ringed tarsi, by the fact that *taeniorhyncus* is a brown mosquito with its proboscis very distinctly ringed with white. *Squamiger* is blackish and only rarely has the white scales of the proboscis concentrated in a definite area entirely encircling the proboscis in a clean-cut band. The larvae of these two forms, which often occur together, may be separated in the fourth stage by the complete ringing of the tenth (anal) segment by the anal saddle in *taeniorhyncus.* Although the imagines of *squamiger* and *dorsalis* are never confused, the larvae are practically inseparable. The only character that is at all useful is the singleness (*dorsalis*) or doubleness (*squamiger*) of the upper pair of dorsal head hairs. Bred *squamiger* material invariably has these hairs double but *dorsalis* varies between having these tufts single or double or with one side single, the other double.

This is the gray salt marsh mosquito. It is the only dark colored, day-biting mosquito of the Californian coast area. In habits and life-history it coincides with its northern cobreeder, *Aëdes dorsalis* (Meig.), except that it has never been observed to desert the brackish water of the salt marshes for breeding purposes although it migrates inland as freely as *dorsalis.* In migrating from the salt marshes, the adults (all females) follow the wooded, fresh-water creeks from which they spread laterally along their courses. This habit has caused the expenditure of large sums in treating these creeks as sources of infestation when they harbored only a few lazy, non-biting *Theobaldia incidens* (Thom.). The migrating females are vicious blood suckers, attacking all warm-blooded animals throughout the day but becoming particularly annoying just before dusk.

The species is restricted to the Californian coast from San Francisco Bay south to San Diego, reaching its greatest numbers at the northern end of its range.

Subgenus **Aëdes** Meig.

This subgenus is founded largely on the very short palpi of both males and females and confirmed by the peculiar modifications of the male terminalia, which have the dististyles articulated subapically and with long arm-like projections. The phallosome is conspicuous and heavily chitinized in contrast to the weak, almost membranous organ in the subgenus *Ochlerotatus.*

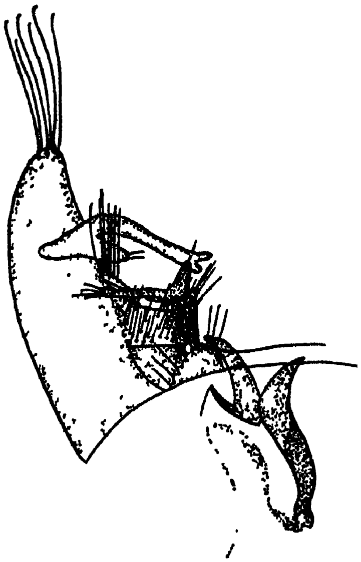

Fig 28. *Aedes cinereus hemiteleus* Dyar. Male terminalia.

Aëdes (Aëdes) cinereus hemiteleus Dyar[8]

Aedes cinereus Meigen, Syst. Beschr Eur. Zweifl. Ins , vol 1, p. 13, 1818.
Aedes cinereus hemiteleus Dyar, Ins. Ins. Mens , vol. 12, p. 179, 1924.

FEMALE. *Head.* Integument brown; occiput with wide stripe of golden brown, narrow, curved scales on vertex, sides with flat white scales flanked by yellowish ones; nape with upright, forked scales; ocular bristles black, clump of pale ones between eyes. Proboscis with uniform vestiture of brownish black scales. Palpi extremely short, black. Tori darker within, where there is a patch of dark scales; antennae black except second segment paler.

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[8] The Palearctic *Aedes cinereus* Meig. differs in the adult from the general Nearctic form which Dyar has called *Aedes cinereus fuscus* O. S. This race, in turn, differs in the width of the stripe of narrow scales on the vertex from all California specimens yet taken.

Thorax. Mesonotum foxy brown, clothed with narrow, curved, brown scales, paler around antescutellar space and extending along lateral posterior margins; a pair of indistinct dark stripes medially and a posterior, lateral pair. Scutellum grayish; vestiture of yellow scales and brown bristles. Pleurae pale brown. Coxae pale with flat white scales and pale bristles; femora and tibiae pale below and metallic brown above; tarsi brown. Claws toothed, -1.1-1.1-1.1. Halteres pale with brown knobs. Wing scales black. Length of wing 3.5 mm.

Abdomen. Dorsal vestiture of metallic black scales with narrow, basal white bands which widen on sides to form continuous or nearly continuous lateral stripes; first segment white scaled with a median black patch. Venter almost entirely white scaled, but with indications of a median dark stripe. Cerci black. Body length 3.5 mm.

Terminalia (fig. 28). Basistyles short and pointed apically; dististyles articulated subapically, with a basal arm and furcate tip; apical lobes absent; basal lobes represented by a shelf-like process, undercut basally, surface rugose and densely setose; beyond these lobes are smooth lacunae at apices of which are many strong setae directed apically. Claspette represented by appendage arising ventrad of basal lobe from membranous surface which joins the two claspettes across penis cavity. At level of upper edge of basal lobe, claspette divides into two slender arms, one extending across upper surface of basal lobe and bearing four setae apically and subapically a knot, also with setae, the other arm, which is shorter, extending apically and bearing a single spine. Phallosome divided into two heavily chitinized lateral halves which form a lyre-like outline and are approximate. Paraprocts prominent, heavily chitinized, recurved, extending from convexity of phallosome to base of basal lobe. Lobes of ninth tergite prominent, lying just cephalad of basal margin of basal lobe, moderate spines present on apex and also on the three knobs occurring on lateral surfaces of lobes.

LARVA (fig. 29). Air tube three and one-half times as long as its width at base, uniformly tapered from base to apex; tracheal ampoules moderate; pecten extending over slightly more than basal half of air tube and consisting of from twelve to fifteen progressively wider spaced teeth; the last two or three, which are in addition to basal portion, are separated by greater spaces and are consequently considered detached; last tooth followed by a three- to five-haired tuft which is distinctly beyond the middle. Anal saddle not ringing segment and bearing a two- or three-haired tuft posteriorly. Dorsal hair and brush moderate, anal gills long, slender and pointed; ventral brush moderate, extending about length of gills, two small tufts preceding ventral brush ventrally. Comb scales of eighth segment about sixteen in number, each scale with a long, sharp, apical thorn, lateral fringe minute and limited to basal part of scale. Dorsal head hairs with both upper and lower tufts multiple. Mental plate acutely conical, apical angle less than 90 degrees; teeth subequal, those at lateral angles stouter, more widely separated, and with knobs interspaced with teeth. Antennae long, slender, and slightly curved, sparsely spinose with stout spines, a multiple hair tuft slightly before the middle; apical armature of two short setae and one long one and a conelike, pedicelated rod.

This small, blackish mosquito, as an adult female, is easily distinguished by the reddish thorax and the lateral stripes at the sides of the abdomen. This latter characteristic is slightly variable in that the lateral projections of the basal, white bands do not always extend quite to the apex of the segment in which case the lateral line is broken slightly. The adult male, although its mesonotum is black, is easily distinguished by its very short palpi and characteristic terminalia. The larva is characterized by the detached teeth of its pecten, limited apically by the hair tuft, and the elongate air tube (3.5 × 1). These characters separate it from all except the larva of *vexans*, from which it is distinguished by its sharp pointed mental plate and the multiple condition of the lower pair of dorsal head hairs.

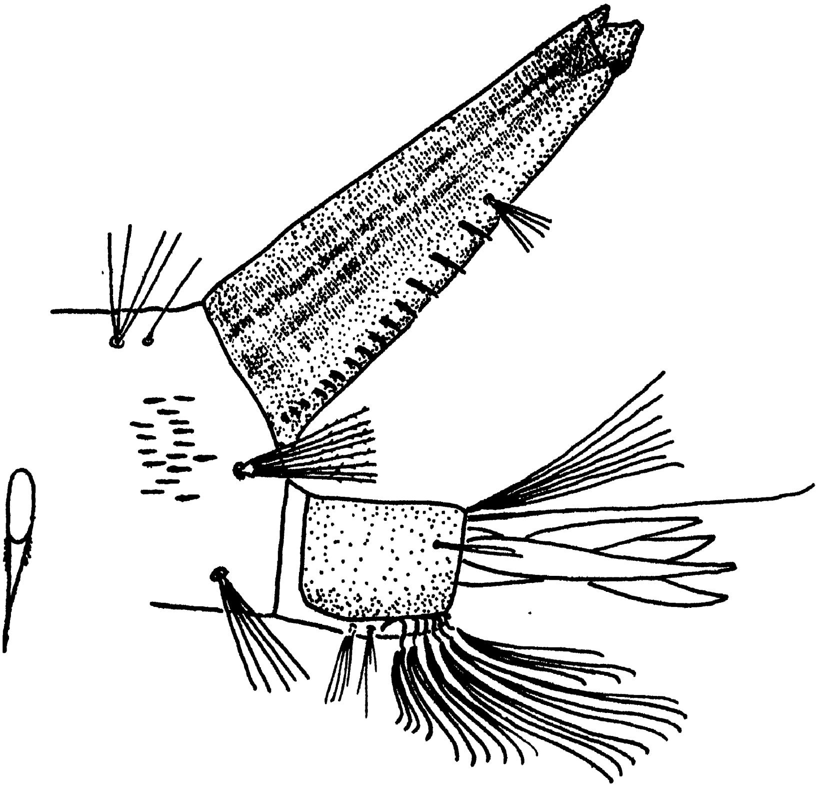

Fig. 29. *Aëdes cinereus hemiteleus* Dyar. Caudal end of larva and enlarged comb scale.

This species with its races is one of the most ubiquitous of the northern *Aëdes* occurring throughout the northern Holarctic. It passes the winter in the egg stage and appears in the early spring shortly after the pools are formed. It is facultative in respect to the type of breeding pool, appearing in shallow, grassy sunlit pools or in deep forest pools. Wesenberg-Lund (1920) has pointed out a characteristic which the writer, through more limited experience, had believed to be a coincidence; viz., the restriction of the adults to the air strata near the ground. The adults are generally taken crawling about on vegetation near the ground and rarely rise high enough in flight to attack the face or neck. A person walking through a heavily infested area will be attacked on the legs by the females that are disturbed by his passage and, if the investigator sits on the ground, his whole person will be invaded. The adults walk wherever it is possible instead of depending on flight as other mosquitoes do. The females are inveterate bloodsuckers of mammalian blood, but the difficulty that they encounter in piercing the skin suggests that they are primarily adapted to obtain their blood from other and thinner skinned animals than man.

In many parts of its range, where intermittent summer rains are common, a second straggling brood is produced late in the summer but in California only a single spring brood is present. The females are evidently long-lived for the writer has taken adult females that were crawling about in hummocks of dried *Bryanthus* at least two months after the nearby pools had dried.

In California, this race is limited to the Sierra crest from Yosemite northward through Plumas County. The race *fuscus* occurs in Oregon, Washington, and across Canada to the Atlantic, dropping into the northern states along the border.

Subgenus **Aëdimorphus** Theob. (= **Ecculex** Felt)

This subgenus, like that of *Aëdes*, is largely characterized by male structures. The only unique feature is the specialization of the male terminalia which lack a lancelike claspette. This is replaced by a hairy, strap-like lobe. Taxonomically, the subgenus is weak, for, with the exception of the modified claspette, no characters are available for the absolute separation of all the members from its allies in the subgenera *Ochlerotatus* and *Aëdes*. Although more closely connected with *Aëdes* both structurally and in distribution, its inclusion with that subgenus would leave no distinctive character for the separation of *Aëdes* from *Ochlerotatus*.

But one species, *Aëdes vexans* (Meig.), is present in the Holarctic, the majority of the species occurring in the Oriental and Ethiopian. None has penetrated to the Neotropical and but one or two occur in the northern part of Australia. The subgenus represents a group close to the primitive stock of the genus *Aëdes* (*sens. lat.*).

Aëdes (Aëdimorphus) vexans (Meig.)

Culex vexans Meigen, Syst. Beschr. Eur. Zweifl. Ins., vol. 6, p. 241, 1820.
Culex articulatus Rondani, Bull. Soc. Entom. Ital., vol. 4, p. 30, 1872.
Culex malariae Grassi, Rend. della R. Acad. dei Lincei, 1889.
Culex sylvestris Theobald, Mon. Culic., vol. 1, p. 406, 1901.
Culex nocturnus Theobald, Mon. Culic., vol. 3, p. 159, 1903.
Culex montcalmi Blanchard, Les Moustiques, p. 407, 1905.
Aedes sylvestris (Theob.) Dyar and Knab, Jour. New York Entom. Soc., vol. 14, p. 194, 1906.
Culicada nipponi Theobald, Mon. Culic., vol. 4, p. 337, 1907.
Culicada minuta Theobald, Mon. Culic., vol. 4, p. 338, 1907.
Culex stenoetrus Theobald, Mon. Culic., vol. 4, p. 395, 1907.
Culicada eruthrosops Theobald, Mon. Culic., vol. 5, p. 229, 1910.
Culex pseudostenoetrus Theobald, Mon. Culic., vol. 5, p. 343, 1910.
Aedes euochrus Howard, Dyar, and Knab, Mosq. No. and Centr. Am. and W. I., vol. 4, p. 716, 1917.

FEMALE. *Head.* Integument black; occiput with yellow and brown narrow, curved scales on vertex with flat black ones followed by white flat ones on sides; erect, forked scales black and white; ocular bristles black, a clump of yellow ones between eyes; a rim of yellow scales surrounding eyes. Tori straw-colored without, dark within; antennae dark except "second" segment is pale at base. Palpi black with a few white scales apically and basally on segments. Proboscis black with yellow scales intermixed at the middle below.

Thorax. Mesonotum brown; vestiture of narrow, straw-colored scales, those of antescutellar space and lateral posterior margins almost white. Scutellum pale with pale scales and pale brown bristles. Pleurae pale brown with whitish scales predominating although those of anterior portion are brown, bristles pale. Coxae yellow with white scales and pale bristles; femora with straw-colored scales below and a mixture of yellow and black ones above, the latter predominating; knees yellow scaled; tibiae similar but with some black ones below, tarsi largely black scaled but with some yellow ones intermixed particularly on first segment; hind tarsi with narrow, basal rings of yellow scales on each segment; the mid- and fore-tarsi without rings on last segment. Tarsi of mid- and fore-leg with claws toothed, -1.1-1.1, those of hind leg generally simple, 0.0 or sometimes 1.0, or 1.1. Halteres white. Wing scales dark brown with metallic luster. Length of wing 4.5 mm.

Abdomen. Dorsal vestiture dull, brownish black with basal band of grayish scales widening on sides to extent that lateral triangles of white thus formed reach nearly to basal band of next segment; first segment largely white scales; distal segments with a few white scales apically on segments. Ventral vestiture of straw-colored scales with a medium black stripe sometimes appearing as median central spot with two subapical, sublateral spots, all three of which may be joined into an inverted 'V' by a very fine, black connecting line. Cerci black. Body length 5 mm.

Male. Coloration as in female except dorsal abdominal bands wider, more suffused, and with little widening at sides. Palpi exceeding length of proboscis by length of last segment (an unusual length for subgenus *Aëdimorphus*), long segment with white ring at middle, last two segments with rings at bases. Claws all toothed, -1.1-1.1-1.1. Length of wing 4.5 mm. Body length 5.5. mm.

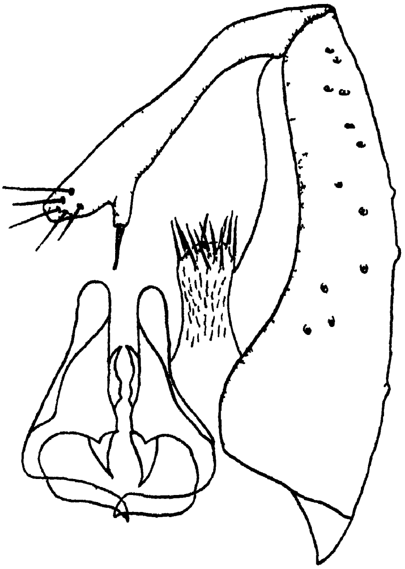

Fig. 30. *Aedes vexans* (Meig.). Male terminalia.

Terminalia (fig. 30). Basistyles stout, about twice as long as width at base; dististyles stout, tapered and minutely setose at tips with subapical arms bearing a claw; apical lobes absent; well-formed, though shallow lacunae are smooth with a clump of setae at their apical extremities. Claspette, represented by a quadrate, hairy strap, bearing at its apical margin a row of stout setae. Phallosome stout, heavily chitinized and apparently formed from lamellate plates divided into two sections medianly. Paraprocts poorly developed. Lobes of ninth tergite small, globular with a few stout, short spines.

Larva (fig. 31). Air tube about three times as long as width at base, tapered to apex from middle; tracheal ampoules moderate; pecten of twelve to fourteen evenly spaced teeth followed by one to three detached teeth and a multiple hair tuft; each tooth of basal portion of pecten a long slender thorn with an expanded base bearing from two to four denticules with one generally larger than the rest. Anal saddle not ringing the segment, a two-haired tuft posteriorly. Dorsal and ventral brushes moderate. Anal gills long and pointed. Comb scales of eighth segment of twelve to fourteen scales in two rows, each scale with long central thorn and very minute basal fringe. Mental plate triangular, apex forming angle of about 90 degrees, teeth subequal, those on lateral margins stoutest. Dorsal head hairs with a distinct upper and lower pair, upper pair double or in threes, lower pair double. Antennae uniformly and slightly tapered, sparsely spinose; a multiple hair tuft slightly before middle; apical armature of a long and short seta inserted very slightly subapically, and a cone-like, pedecilated rod, stout blunt spine, and palpus-like appendage, chitinous at base and membranous apically.

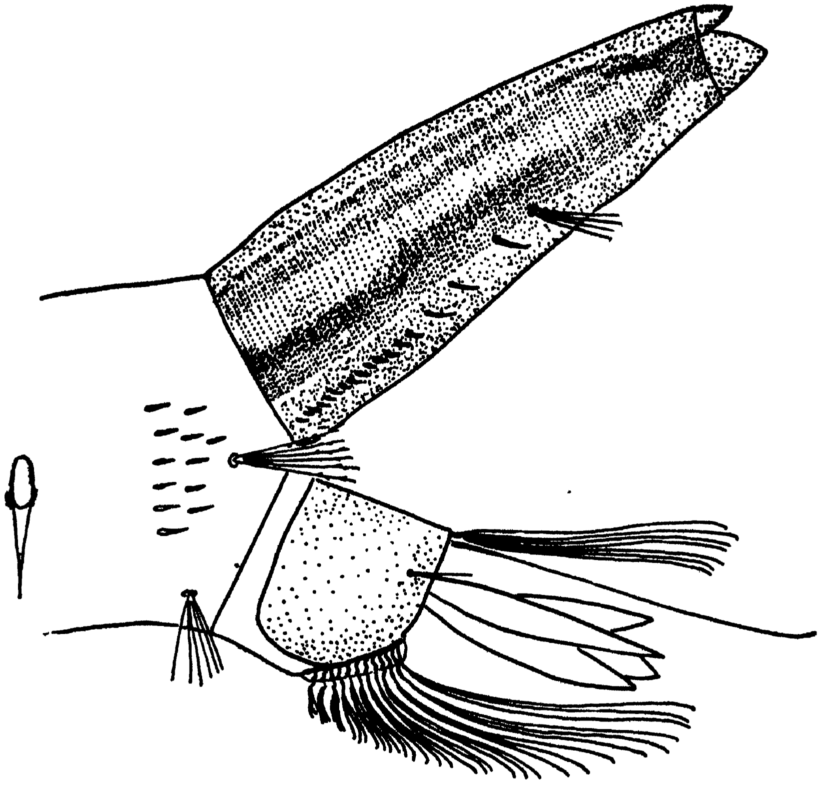

Fig. 31. *Aëdes vexans* (Meig.). Caudal end of larva and enlarged comb scale.

Adults considerably varied in coloring, some specimens appearing distinctly gray white, while others brown. Dorsal banding of abdomen subject to variations in width and in amount of median constriction so that some individuals show very definite widening at sides while others have band approximately even.

Adults separated from other *Aëdes* havng the tarsi basally banded by rather simple characters; *taeniorhyncus* distinguished by its white banded proboscis; and those of the *stimulans* group of *Ochlerotatus*—*squamiger*, *increpitus*, and *fitchi palustris*—all have more or less white scaling on wings, those of *vexans* remaining uniformly brown.

This ubiquitous bloodsucker breeds in greatest numbers in wooded swamps and along the edges of rivers subject to overflow. The eggs are deposited in typical *Aëdes* fashion on the muddy edges of receding pools, four to eight being the average complement. If the eggs are deposited along the edge of the pool in the tiny depressions that are filled with water, they sink to the bottom immediately. Each egg is fusiform, roughly reticulated, and becomes shining black a few minutes after oviposition.

Unlike the eggs of many *Aëdes*, those of *vexans* hatch if moisture is supplied during the same season. This facilitates, in favored locations, the production of many broods during the season. At Bakersfield, the Kern river bottom is higher than the surrounding lands adjacent to its banks. With each rise of the river occasioned by melting snow or thunder storms at its sources, the riparian seepage fills low-lying depressions and a new brood of *vexans* is produced. The species is single brooded in many sections where the spring flooding is the only source of moisture, as in the Sacramento Valley. The small tributaries of the Sacramento are raging torrents during the late spring and when they overflow their banks numerous equally swift currents race through their wooded valleys. As the torrent subsides, the subsidiary channels are cut off from the main stream at intervals, and as soon as the contained water in these isolated meanders becomes stagnant, myriads of *vexans* larvae make their appearance. How the eggs laid during a previous season can withstand the floods that move tree trunks, tear away great portions of the banks, and perform numerous Herculean tasks is a mystery that has never been explained; yet each year finds the same pools swarming with larvae hatched from eggs which must have been laid during the previous spring. In the northern Sacramento, the first (and last) brood emerges from April to May, the last larvae pupating during the second week in May. To the south, the freshets are earlier and the broods consequently emerge sooner.

The species is Holarctic in range, occurring in northern Europe, Asia, and North America. In California, it is common from the Tehachapi northward through the central valley to the latitude of Red Bluff wherever wooded stream beds are present.

Subgenus **Culicelsa** Felt[9]

This group is unrepresented in the Palearctic region and [illegible] range in the Western Hemisphere is distinctly southern. The main points which divide this subgenus from the other subgenera of *Aëdes* are the absence of the apical lobe of the male terminalia and the presence of a well developed claspette. This combination forms one more link between *Ochleoratatus* with its full complement of basal and apical lobes and claspette and the subgenera *Aëdes* and *Aëdimorphus* with their modified claspettes and dististyles. The basistyles of *Culicelsa* are essentially as in *Aëdimorphus* but the claspettes are as in *Ochlerotatus*. The male palpi of the different species of the subgenus also show a range of variability that is suggestive of their intermediate position, some exceeding the proboscis by the length of the last segment and others being only three-fourths as long as the proboscis.

Aëdes (Culicelsa) taeniorhyncus (Wiedmann)

Culex taeniorhynchus Wiedemann, Dipt. Exot., p. 43, 1821.
Culex damnosus Say, Jour. Acad. Nat. Sci. Phila., vol. 3, p. 11, 1823.
Aëdes taeniorhynchus (Wied.), Busck, Smiths. Misc. Colls., vol. 52, p. 63, 1908.

Female. *Head.* Integument dark brown; occiput with narrow, curved, pale brown scales on vertex, those at side flat and white with a row of black flat scales caudad of the white scaled eye margins; erect, forked scales black and dense at nape; bristles dark. Tori brown with a patch of white scales on inner surfaces; antennae black. Palpi short, black, ends of segments with some white scales. Proboscis brownish black with a ring of white scales at middle.

Thorax. Mesonotal integument dark brown; vestiture of narrow, curved, deep brown scales darker anteriorly and centrally, paler, almost white about antescutellar space and along lateral posterior margins. Pleurae dark brown, coxae paler and both sparsely clothed with white scales and pale bristles. Femora black scaled above and encircling tips, otherwise white; knees white; tibiae black with a few yellowish scales above and almost entirely so beneath; tarsi black except for some white scaling on first segment of fore- and mid-tarsi; hind tarsi with broad white basal bands, last segment wholly white. Claws toothed on fore- and mid-tarsi, 1.1-1.1-0.0. Wing scales black. Length of wing 3.8 mm. Halteres white.

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[9] Among most American writers this subgenus has been known as *Taeniorhyncus*. Lynch-Arribalzaga erected the genus *Taeniorhyncus* and made what he thought was Wiedemann's *taeniorhyncus* the type. He had before him, however, as his descriptions show, Walker's *titillans* that American authors have placed in the genus *Mansonia* Blanchard. As we must consider the facts and not the suppositions, *Taeniorhyncus* replaces *Mansonia* and the *Aëdes* element takes the name *Culicelsa* Felt, the next generic name to be applied to this group.

Abdomen. Dorsal vestiture of black scales with narrow, basal, segmental bands of grayish yellow scales and bright, lateral, median, segmental spots becoming progressively larger posteriorly. Ventral vestiture of dull white scales with apical black bands, segments very narrowly fringed with white scales apically. Cerci black. Body length 4.2 mm.

MALE. Coloration similar to female except basal bands of dorsal abdominal vestiture wider and lateral spots absent on anterior segments. Palpi about same length as proboscis, long segment white-ringed before the middle, the last two at their bases. Claw formula, 2.1-1.1-0.0. Body length 4.5 mm. Wing length 3.5 mm.

Terminalia. Basistyles stout, lacunae present but indistinct; dististyles decidedly swollen centrally with long, slender, terminal claws; apical lobes absent; basal lobes represented by slight elevations bearing many setae, those situated apically rather stout and short and those basally on lobes longer and more slender. Claspette with shaft minutely setose, slightly bowed, and bearing two setae inwardly, one near base and the other just beyond the middle; appendage nearly as long as shaft with long, slender, retrorse spur just beyond the middle, portion beyond spur narrowing to a dull point. Phallosome inconspicuous, conical. Paraprocts with heavy chitinizations, tips recurved. Lobes of ninth tergite small and flattened with a very few stout bristles.

LARVA. Air tube short and stout, one and one-half times as long as its width at base, slightly tapered beyond the middle; pecten of evenly spaced teeth reaching about to middle of tube, each tooth a long thorn with two to four basal denticules. Anal saddle completely ringing segment; a single hair posteriorly; dorsal and ventral brushes well developed but short. Anal gills very short. Comb scales of eighth abdominal segment in a triangular group of eighteen to twenty scales, each scale spatulate with well developed thorns without a single apical differentiated thorn although apical ones stouter than those basally situated. Mental plate triangular with a large apical tooth, lateral ones more widely separated. Dorsal head hairs single. Antennae slightly and uniformly tapered, sparsely and minutely spinose, a multiple hair tuft at the middle; apical armature of a long seta and two short ones, a pedecilated conelike rod, and a palpus-like appendage, membranous at tip and chitinous basally.

The white banded proboscis and the generic characters of *Aëdes* (*sens. lat.*) are sufficient for the diagnosis of this mosquito in California as it is the only *Aëdes* having the proboscis completely and distinctly banded. The larva is distinguished from all other *Aëdes* larvae by its evenly spaced pecten, ringed anal segment, and evenly fringed comb scales of the eighth abdominal segment.

Although this species is typically a salt marsh breeder and is never to be found breeding far away from this type of location, it is not definitely bound to brackish water. The majority of the members breed in water supplied by the monthly "rip" tides, frequenting shallow marsh pools bordered by pickerel weed. They seem particularly fond of man-made pools such as stagnant ditches or high water pools formed by dikes, railroad embankments, or similar obstructions. In the vicinity of salt marshes, they may be found in numbers in perfectly fresh, potable water but, although they migrate far inland, the author has never seen any evidence of breeding in fresh water that is not contiguous to salt marshes.

The eggs are laid, like those of *dorsalis* and *squamiger,* on the muddy edges of the receding pools and evidently require months of dormancy before hatching. The first well-recognized brood emerges in April as the result of the March tide, and monthly thereafter throughout the summer. The peak of production is reached in the June and July broods, after which each monthly brood shows a diminution in numbers and a dilution with *Aedes squamiger* (Coq.).

The species has the most rapid metamorphosis of any of the Californian species. The May brood passes through its developmental stages in approximately ten days and the June and July broods frequently require only eight days, the larvae developing in the first four days from the egg to the final larval instar.

This is the brown salt marsh mosquito of southern California— the pest of the bathing beaches. It extends up the Atlantic Coast as far north as Connecticut and up the Pacific Coast along the southern part of the Californian coast to Santa Barbara, where it is replaced by *Aedes dorsalis* (Meig.).

Aëdes (Culicelsa) varipalpus (Coquillet)

Culex varipalpus Coquillett, Canad. Entom., vol. 34, p. 292, 1902.

Taeniorhyncus sierrensis Ludlow, Canad Entom., vol. 37, p. 231, 1905.

Aedes varipalpus (Coq.) Dyar and Knab, Jour. New York Entom. Soc., vol. 14, p. 200, 1906.

FEMALE. *Head.* Integument black; occiput with yellowish white, narrow, curved scales on vertex, those at side flat and white with two subequal patches of flat, black ones; nape with pale, erect, forked scales; bristles black. Tori dark with a large patch of white flat scales on inner sides; antennae black scaled except second segment which has white scales ringing basal portion or confined to inner side. Palpi about one-fourth the length of proboscis, black scaled except at apices of segments which are white scaled, the last segment prominently so, the others sometimes obscurely. Proboscis with black scales throughout.

Thorax. Mesonotum with integument black; vestiture of light yellow and coppery, narrow, curved scales forming very variable patterns in conjunction with bare stripes and areas; a tendency toward production of a golden median stripe. Scutellum dark with white, flat scales and black bristles. Pleurae brown. Coxae paler, and both with flat scales and pale bristles; femora with black and white scales intermixed, white ones predominating basally, black ones, apically; knees white; tibiae with shining black scales, a scattering of white ones at both ends of segment; tarsi black scaled; those of hind leg with each segment broadly and sharply white-ringed at both base and apex, the last segment wholly white; those of mid- and fore-tarsi white-ringed at base and apex of first three segments, the last entirely black except for presence of a scattering of obscure yellow scales corresponding to bands of hind tarsi; claws of fore- and mid-tarsi toothed, 1.1-1.1-0.0. Wing scales brown, a small white spot at base of costa. Length of wing 3.5 mm. Halteres pale.

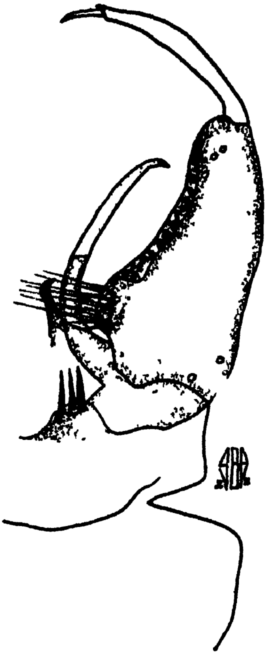

Fig. 32. *Aedes varipalpus* (Coq.). Male terminalia.

Abdomen. Dorsal vestiture of black scales with a narrow, basal, white band, extended in the middle triangularly and again laterally; first segment white scaled; posterior segments with some apical white scales. Ventral vestiture of white scales with apical black bands divided medianly by white scaling except on posterior segments; extreme apices of segments with some white scales. Cerci black. Length of body 4 mm.

MALE. Coloration as in female except dorsal abdominal bands not produced or constricted but forming broad, even bands. Palpi as long as the proboscis, bases of last two segments broadly ringed with white, that of long segment with a partial ring. Claws of mid- and fore-tarsi toothed, -2.1-2.1-0.0.

Terminalia (fig. 32). Basistyles conical, small, about two and one-half times as long as width at base; lacunae distinct but shallow and clothed with long setae; diststyles slender, very slightly swollen in the middle, with slender, apical claws. Apical lobes absent, basal lobes present as slight protuberances, heavily haired with slender uniform setae. Claspette with a stout, curved shaft and appendage of equal length, uniformly tapered to point without swellings or projections. Phallosome almost membranous, cylindrical. Paraprocts not conspicuous, tips of chitinization revolute. Lobes of ninth tergite small with three or four stout bristles each.

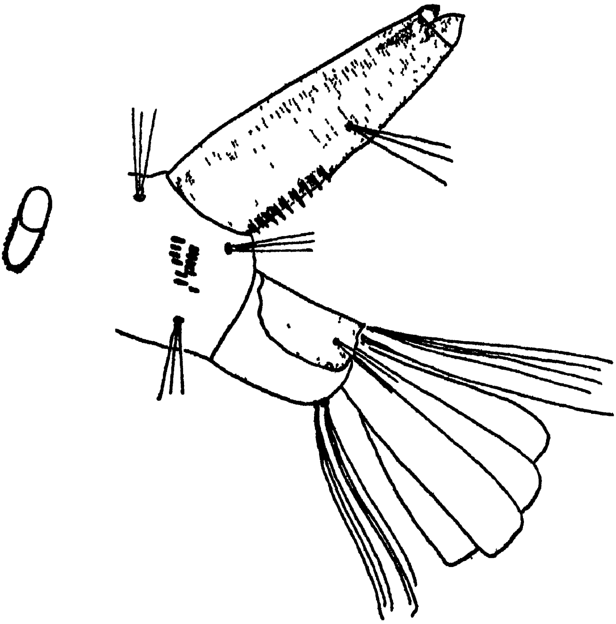

Fig. 33. *Aedes varipalpus* (Coq.). Caudal end of larva and enlarged comb scale.

Larva (fig. 33). Air tube slender, approximately three times as long as width at base; tracheal ampoules swollen, with a distinctive widening into sac-like cavities in posterior part of thorax; pecten of nine to eleven evenly spaced teeth, each tooth with a broad base bearing from one to four denticules, one very much larger than the others; a multiple hair tuft, generally in threes at middle of tube. Anal saddle reaching halfway down sides of segment, a two-haired tuft posteriorly; dorsal brush reduced to a four-haired tuft and the single dorsal hair on each side, ventral brush also reduced in number of tufts and in length. Anal gills distinctive in that they are three-fourths the length of air tube, snowy white, and almost square tipped. Comb scales of eighth abdominal segment in two rows totaling approximately twelve scales, each scale slipper-shaped with broad toe and heel, apical half with fringe of very minute, hair-like thorns. Mental plate triangular with teeth subequal, those at lateral margins stoutest and most widely separated. Dorsal head hairs single. Antennae smooth and entirely unspined, with very little taper; a single hair in the middle; apical armature of two short setae and one long one, a conelike, pedicelated rod, and a palpus-like appendage, chitinous at base and membranous apically.

The bright white markings of the legs at both bases and apices of the tarsal segments immediately distinguish this *Aëdes*. *Aëdes dorsalis* (Meig.), which shares this type of banding of the tarsi, is easily differentiated by the dull yellowish, indistinct banding and its generally brown color. The larvae are easily distinguished with the naked eye by their long, white, swollen gills, bright brown head, and their snaky chironomid-like progress in the water. Microscopically, the distinctive characters are the smooth, unspined condition of the antennae and the minute fringing of the slipper-shaped comb scales of the eighth abdominal segment.

This tiny mosquito is one of the most interesting of the Californian species. The eggs, deposited on the sides of tree holes harboring water, hatch whenever they are wet by the rising waters. There is some evidence that the eggs may drop off after a period of desiccation or, as an alternative method, the larvae may hatch without the intervention of actual wetting and fall into the water below. The straw-colored larvae with bright brown heads and enormously developed gills swim about their secluded medium with snake-like movements, but spend most of their time with their heads and thoraces buried in the silty deposit at the bottom of the tree holes. Transferred to a glass vial in their natural medium, all that can be seen of the larvae is a host of lashing abdomens protruding from the settled deposit.

The developmental period is extremely long, lasting from one to seven months. Although there is an intermingling of the broods, there are two pronounced peaks, one in the early summer and another in the fall. The fall adults deposit eggs which produce the larvae that over-winter. In May of the following spring, these larvae are full-grown and pupate in a leisurely fashion to emerge as adults in late May or June. The eggs of this generation undoubtedly furnish the starting point for the fall brood, but there is such a straggling of the early summer emergences that it is difficult to state this positively.

Mating takes place near the host, the males frequenting the vicinity of the victims of the females. In doing this, they give every indication of preparing to bite but are not able to pierce the skin. The females are so small that they easily pass through a fourteen or sixteen mesh screen and constitute a serious plague when they become numerous.

The live oaks (*Quercus agrifolia* Neé) and the valley oaks (*Quercus lobata* Neé) furnish the most favorable breeding places.

The species occurs throughout the Pacific Coast region from southern California to British Columbia. In California, they are found wherever their favorite breeding trees occur, but become numerous and consequently troublesome only in sections of the southern part of the State and throughout the central valley.

Genus **Culex** Linnaeus

Culex Linnaeus, Syst. Nat., ed. 10, p. 602, 1758.
Melanoconops Theobald, Mon. Culic., vol. 3, p. 178, 1903.
Lasioconops Theobald, Mon. Culic., vol. 3, p. 235, 1903.
Melanoconion Theobald, Mon. Culic., vol. 3, p. 238, 1903.
Heptaphlebomyia Theobald, Mon. Culic., vol. 3, p. 336, 1903.
Aedinus Lutz, *in* Bourroul, Mosq. do Brazil, p. 54, 1904.
Neoculex Dyar, Proc. Entom. Soc. Wash., vol. 7, p. 45, 1905.
Tinolestes Coquillett, Proc. Entom. Soc. Wash., vol. 7, p. 185, 1905.
Micraedes Coquillett, Proc. Entom. Soc. Wash., vol. 7, p. 185, 1905.
Gnophodeomyia Theobald, Jour. Econ. Biol., vol. 1, p. 21, 1905.
Trichopronomyia Theobald, Ann. Nat. Mus. Hung., vol. 3, p. 98, 1905.
Carrollia Lutz, Imprensa Med., p. 81, 1905.
Pseudoheptaphlebomyia Ventrillon, Bull. Mus. Nat. Hist., Paris, p. 427, 1905.
Isostomyia Coquillett, U. S. Dept. Agr., Bur. Entom., Tech. Ser. 11, p. 16, 1906.
Mochlostyrax Dyar and Knab, Jour. New York Entom. Soc., vol. 14, p. 233, 1906.
Jamesia Christophers, Sci. Mem. Med. Ind., n.s., no. 25, p. 12, 1906.
Culiciomyia Theobald, Mon. Culic., vol. 4, p. 227, 1907.
Aporoculex Theobald, Mon. Culic., vol. 4, p. 150, 1907.
Pseudoculex Theobald, Mon. Culic., vol. 4, p. 318, 1907.
Leucomyia Theobald, Mon. Culic., vol. 4, p. 372, 1907.
Microculex Theobald, Mon. Culic., vol. 4, p. 461, 1907.
Oculeomyia Theobald, Mon. Culic., vol. 4, p. 515, 1907.
Neomelanoconion Newstead, Dutton, and Todd, Ann. Trop. Med. and Par., vol. 1, p. 31, 1907.
Pectinopalpus Theobald, Ann. Mag. Nat. Hist., ser. 8, vol. 5, p. 375, 1910.
Eumelanomyia Theobald, Mon. Culic., vol. 5, p. 114, 1910.
Phalangomyia Dyar and Knab., Ins. Ins. Mens., vol. 2, p. 58, 1914.
Climacura Howard, Dyar, and Knab, Mosq. N. and Centr. Am. and W. I., vol. 3, p. 452, 1915.
Transculicia Dyar, Ins. Ins. Mens., vol. 5, p. 184, 1917.
Cacooculex Dyar, Ins. Ins. Mens., vol. 6, p. 100, 1918.
Choeroporpa Dyar, Ins. Ins. Mens., vol. 6, p. 103, 1918.
Helcoporpa Dyar, Ins. Ins. Mens., vol. 6, p. 125, 1918.
Eubonnea Dyar, Ins. Ins. Mens., vol. 7, p. 150, 1919.
Barraudius Edwards, Bull. Entom. Res., vol. 12, p. 332, 1921.

This is essentially a genus of tropical and subtropical mosquitoes. Only one species has a purely natural Holarctic range, *Culex apicalis* Adams, but two other species, *Culex pipiens* L. and *Culex quinquefasciatus* Say, have followed the commerce of the world and are now cosmopolitan. Edwards (1921) has recently pointed out that the genus is characterized by the presence of pulvilli, which have been overlooked and even stated as absent by most authors. In addition to this rather difficult determination, the genus is easily distinguished from other Californian genera by the blunt abdomen of the female; the trilobed condition of the scutellum; the absence of prespiracular bristles; and the presence of microtrichia on the wing membrane. The first characterization precludes *Aëdes;* the second, *Anopheles;* the third, *Theobaldia;* and the last, *Uranotaenia.* Other characters that distinguish the genus are: tarsal claws of the female always untoothed; eyes contiguous or nearly so above the antennae; first segment of the hind tarsi as long or longer than the tibiae; cerci short, broad, rooflike; and the three spermathecae nearly always of equal size (although one may be slightly larger). The male terminalia are decidedly distinctive. The basistyles bear subapical lobes which are ornamented with modified setae, but the basal lobes and claspettes of *Aëdes* are absent. In their place, the phallosome has become richly ornamented with lamellate or outspreading plates or horns laterally, and the parameres or inside walls of the penis cavity have become heavily chitinized and conspicuous. The chitinization of the paraprocts takes two characteristic phases, occurring as a dense crown of heavy spines or as pectinate crests. The appearance of the paraprocts is the easiest and most reliable guide in the generic determination of *Culex* terminalia. The modifications of the subapical lobe and the heavy ornamentation of the lateral plates of the phallosome have accomplished the same results in the excavation of the inner and anal surface of the basistyles as has the production of the basal and apical lobes and claspette in *Aëdes.* Lacunae are present on the inner surface of the basistyles of *Culex,* but they have not produced the distinct dorsal and ventral flaps of *Aëdes.* They seem to be formed by the inward curving of the ventral edge and the projection of the base of the subapical lobe, thus leaving a hollow molded to the outline of the proctiger and the phallosome.

The larvae are characterized by long air tubes, generally with several multiple hair tufts; by having the anal saddle completely encircling the segment in the full-grown larva; by lacking other chitinous plates on the abdominal segments except for hair insertions; by dorsal head hairs double or multiple and in a transverse alignment; by antennae notched for the insertion of the hair tuft and unspined beyond that point.

The species occurring in the United States are divided into five subgenera on the basis of the male terminalia: *Neoculex* Dyar, *Culex* Linnaeus, *Melanoconion* Theob., *Choeroporpa* Dyar, and *Mochlostyrax* Dyar and Knab. Of these, three are represnted in California, *Neoculex, Culex,* and *Choeroporpa.* They tabulate as follows:

1. Paraprocts tufted with spines 2
   Paraprocts pectinate .... **Choeroporpa** Dyar.
2. Phallosome simple .... **Neoculex** Dyar.
   Phallosome ornate .... **Culex** Linnaeus.

KEY TO CALIFORNIAN SPECIES OF CULEX

Adults

1. Proboscis banded with white 2
   Proboscis unbanded 3
2. With V-shaped dark marking on venter of each abdominal segment; a white line on outside of femora and tibiae .... **tarsalis** Coq.
   With black median spot on venter of each abdominal segment, without white line on outside of femora and tibiae .... **stigmatosoma** Dyar.
3. Tarsi without pale rings 4
   Tarsi with pale brown rings at both ends of segments .... **territans** Walker
4. Dorsal abdominal bands basal 6
   Dorsal abdominal bands apical .... **apicalis** Adams.
   Dorsal abdominal bands absent 5
5. Vertex of head with broad, ovate scales .... **anips** Dyar.
   Vertex of head with narrow, hair-like scales .... **badgeri** Dyar.
6. Thorax light red before; mesonotum clothed with hair-like scales .... **erythrothorax** Dyar.
   Thorax not light red before; mesonotal scales normal 7
7. Abdominal bands widest in the middle, separated from lateral spots .... **quinquefasciatus** Say.
   Abdominal bands normal, contiguous to the lateral spots .... **pipiens** L.

Larvae

1. With four or more pairs of tufts on air tube 2
   With one pair of tufts and a few scattered single hairs .... **territans** Walk.
2. Subapical tuft of air tube moved laterad out of line 3
   All tufts of air tube in line 6
3. Subdorsal hairs of third and fourth abdominal segments double 4
   Subdorsal hairs of third and fourth abdominal segments single or in threes 5
4. Air tube 7 × 1, tapered .... **erythrothorax** Dyar.
   Air tube 5 × 1, fusiform .... **pipiens** L.

5. Subdorsal hairs of third and fourth abdominal segments single .... **quinquefasciatus** Say.
   Subdorsal hairs of third and fourth abdominal segments in threes .... **stigmatosoma** Dyar.
6. Air tube 4 × 1, subdorsal hairs of third and fourth abdominal segments in threes .... **tarsalis** Coq.
   Air tube 7 × 1, subdorsal hairs of third and fourth abdominal segments double .... **apicalis** Adams

The larvae of *C. anips* Dyar and *C. badgeri* Dyar are unknown.

Male Terminalia

1. Paraprocts with a tuft of apical spines 2
   Paraprocts with a comb-shaped apical process .... **anips** Dyar.
2. Lateral plates of phallosome furcate 3
   Lateral plates of phallosome not furcate .... **apicalis** Adams.
3. Subapical lobe with five or six appendages 4
   This part with additional appendages 7
4. Outer plate of phallosome denticulate 6
   This plate entire 5
5. Toothed plate of phallosome with the hornlike arm moderate, but little exceeding the teeth .... **erythrothorax** Dyar.
   This plate with the hornlike arm long, flattened, and projecting.... **badgeri** Dyar.
6. Leaf of subapical lobe clublike; outer spines of crest of paraprocts blunt and broad .... **tarsalis** Coq.
   Leaf of subapical lobe and spines of crest of paraprocts normal .... **stigmatosoma** Dyar.
7. Inner process of phallosome long, leaf-like and extended 8
   Inner process of phallosome short .... **territans** Walk.
8. Inner process of phallosome expanded leaf-like distally; without a blunt tubular process .... **quinquefasciatus** Say.
   Inner process of the phallosome long and curved but not expanded distally; one process thick and tubular .... **pipiens** L.

Subgenus **Choeroporpa** Dyar

This subgenus has its greatest development in Dutch Guiana (Surinam) but occurs to the north and south in temperate climates. It shares with the subgenera *Melanoconion* and *Mochlostyrax* the flattened aspect of the paraprocts with their distal projections, and is separated from them by its elongate dististyle with a snoutlike tip, the former having the clasper normal, the latter with a capitate tip.

Culex (Choeroporpa) anips Dyar

Culex anips Dyar, Ins. Ins. Mens., vol. 4, p. 48, 1916.

MALE.[10] "Proboscis long, moderately slender, scarcely at all swollen apically, smoothly black scaled, the labellae paler and brownish, smooth, without setae. Palpi long, slender, smooth, far exceeding proboscis, the first segment reaching nearly to end of palpi, with a few stiff black setae at its tip; second and third segments slender, smooth, upturned, the third with a few short setae, all black-scaled. Antennae plumose, the last two segments long and slender. Occiput clothed with appressed blackish scales, the margins of the eyes broadly white-scaled; erect forked scales on the nape brownish. Mesonotum dark brown, thickly clothed with narrow curved bronzy-brown scales, the submedian rows of black setae forming two darker lines. Pleurae dull greenish with a few white scales. Coxae pale, a little greenish. Abdomen subcylindrical, flattened, expanded at tip; dorsal vestiture deep black, slightly bluish, no dorsal bands, a series of rounded white lateral spots, basally on the segments, faint on the first four segments, distinct on the next three; ventral segments broadly black-scaled at apices, dull whitish at bases, the colors suffused, not sharply banded; lateral ciliation of weak, short recurved hairs, very slight. Wing scales black, the stems of the fork cells short. Legs rather long and slender, clothed with black scales; femora white beneath, narrowly so nearly to apex, no knee-spots; femora and tibiae with a very few black bristles.

"Length. body, about 3 mm.; wing, 2.5 mm.

"*Terminalia.* The clasp-filament [dististyle] is thickly snout-shaped, with a crest of rather long hairs on top; the tip curves up in a sharp point, the spine being slender and not appendiculate. The outer division of the lobe of side piece [basistyle] has two slender arms, the outer one of which bears a large leaf; the inner arm has the short filament apical, the long one subapical; middle filament at base of inner arm; no others; a seta on the stem below the outer arm. Second uncal plate furcate, one limb horn-like; no third spine; but on the slender first plate, from which the basal hooks arise, is a stout spine about the middle. Basal lobes [lobes of ninth tergite] very small, irregularly triangular.

"FEMALE. As in the male except palpi short, about three times as long as the clypeus; antennae with the segments subequal; abdomen with the white lateral spots larger, subtriangular, venter sordid white-scaled, only the last segment marked with black.

"Length: Body, about 3 mm.; wing, 2.8 mm.

"LARVA. Unknown. Pupae exceedingly minute."

This species has been taken at only one point by a single investigator. Dyar bred the type material from pupae taken in an isolated pool at the mouth of the San Diego River in the early part of May, 1916. The pool was a large one, 50 by 300 feet, deep, with a fringe of cat-tails and mats of *Lemna*. *Erythrothorax* larvae were present as well as fish. The writer diligently searched for larvae of this species in June of 1918 at the type locality but no larvae or adults of this species were found, catches being almost entirely made up of *Culex erythrothorax* Dyar and *Theobaldia inornata* (Will.). It is the sole representative of the subgenus not only in California but on the entire west coast of the United States.

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[10] Dyar, Ins. Ins. Mens., vol. 4, pp. 48–49, 1916, and vol. 8, pp. 54–55, 1920.

Subgenus **Neoculex** Dyar

Edward (1921) has submerged this subgenus within *Culex* (*sens. str.*) on account of the fact that the characters of the male terminalia are connected by a series of gradations through other allied species, such as *Culex sinensis* Theob. and *Culex quasigelidus* Theob., with the typical *Culex* structure. While this is undoubtedly true, we have retained the subgenus for the sake of consistency with our treatment of *Aëdes* (*sens. lat.*), where similar interrelations have been pointed out among the recognized subgenera. Also the distribution of this species as the only natural member of both the Palearctic and Nearctic regions justifies a subdivision if upheld by structural characters. No larval characters are present that separate the subgenus, but the phallosome is much simpler than in *Culex* (*sens. str.*). The plates of this organ lack the prominent processes of *Culex* (*sens. str.*) so that the phallosome has the appearance of being formed of two lateral upright plates without ornamentation but joined together by a ventral bridge about halfway down from the apex.

Culex (Neoculex) apicalis Adams[11]

Culex apicalis Adams, Kans. Univ. Sci. Bull., vol. 2, p. 26, 1903.
Culex sergenti Theobald, Mon. Culic., vol. 3, p. 218, 1903.
Culex saxatilis Grossbeck, Canad. Entom., vol. 37, p. 360, 1905.
Culex frickii Ludlow, Canad. Entom., vol. 38, p. 132, 1906.
Culex pyrenaicus Brolemann, Ann. Soc. Entom. France, vol. 87, p. 427, 1919.

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[11] In California, this mosquito, through a misinterpretation in this country, has been called, for many years, *Culex territans* Walker, while the species to which *territans* rightfully belongs has been called *restuans* Theobald. Edwards of the British Museum has compared Walker's type *territans* with Theobald's *restuans* and finds them to be identical. *Territans* takes precedence and must hereafter be applied to the species known in this country as *restuans*. The Holarctic form previously known as *territans* was referred by Dyar to *saxatilis* Grossbeck, 1905, in the belief that *apicalis* Adams, 1903, was antedated by Theobald's *apicalis*, 1903, from Brazil. Theobald, believing that Adams' species antedated his, in 1910 changed his *apicalis* to *neoapicalis*. The name *testaceus* Van der Wulp, 1867, has also been applied to this species as well as to an *Aëdes*, but finally has been associated definitely with *Taeniorhyncus perturbans* Walk., of which it becomes a synonym.

Female. *Head.* Occiput brownish with narrow, curved cream-colored scales, margins of eyes and lateral areas of head whitish scaled with a black spot in some specimens; nape with brown, upright, forked scales. Proboscis uniform with brownish scales, a few yellow ones at tip. Palpi one-fifth to one-fourth the length of proboscis, brownish black. Tori pale on outer surfaces, dark within; segments of antennae with a brown pilosity, hairs of whorls sparse and black.

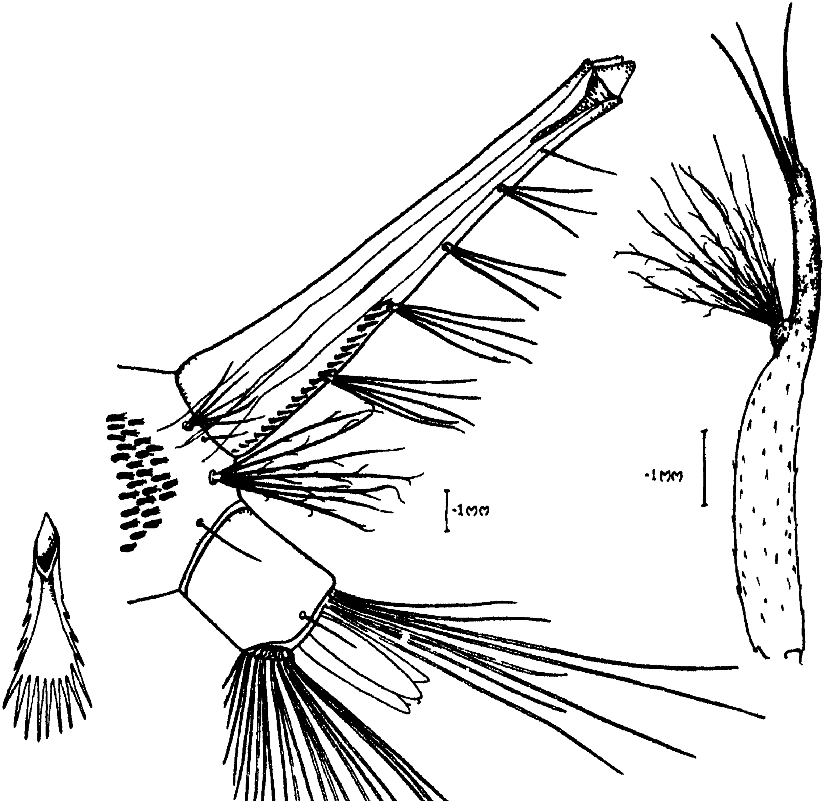

Fig. 34 *Culex apicalis* Adams. Caudal end of larva with enlarged comb scale at the left and antenna at the right.

Thorax. Mesonotum brown with two longitudinal dark lines; vestiture of pale brown, curved scales, paler at margins and in antescutellar space; two yellow circles may or may not be present on the mesonotum subdorsally. Scutellum paler, with many tiny, pale, curved scales and brown bristles. Postscutellum nude, greenish brown with a median carina Pleurae brown with white scales and bristles. Coxae brown with a few white scales; femora dark with some pale scales below; tibiae white below nearly to tip, bronzy black above; knees minutely white; first tarsal segment minutely white at base otherwise tarsi black; claws simple, 0.0-0.0-0.0. Wing scales dense, linear, and black. Halteres pale with a pale or dark knob.

Abdomen. Dorsal vestiture bluish black with broad apical band of sordid white scales widening at sides. Ventral vestiture sordid white with dark membranous line basally on each segment caused by absence of scales. Body length 3.0 mm.

MALE. Coloration as in female. Palpi somewhat thickened apically, long, exceeding length of proboscis by length of last two segments. Antennae with last two segments long and black, the others short and pale. Claw formula, 1.1-1.1-0.0. Body length 4.5 mm.

Terminalia. Subapical lobes not prominent, each bearing seven appendages, two of which are rod-like, expanded at tip, the next two serrated, and other three simple setae. Basal portions of basistyles thickened. Parameres small and inconspicuous. Median processes of phallosome erect, pointed, and longer than tufted paraprocts. Lobes of ninth tergite small and globular.

LARVA (fig. 34). Air tube seven times as long as its width at base, slender, tapering to expanded apex; pecten on basal third of tube of evenly spaced teeth, each tooth with from two to four denticules basally; four hair tufts on each side of air tube beyond pecten. Lateral comb of eighth segment of many scales, each scale spatulate distally and fringed with fine, even thorns. Anal segment long and narrow, ringed by a plate bearing single lateral hair on each side. Anal gills rounded, longer than segment. Head extremely large and quadrate, antennae long, thickened basally, and finely spinose to multiple hair tuft situated about two-thirds of length from head; apical third slender, smooth, and bearing two long hairs before the apex, which bears a digit, a short and a long hair. Dorsal head hairs variable; sometimes both single but Californian specimens tend to have upper ones double and lower ones single. Mental plate roughly quadrate, apical tooth largest, with series of subequal ones on each side followed by two small ones on each side at lower corners.

Although confusion in the taxonomy of this species has given rise to many conflicting observations, the species may be readily distinguished in the adult form from all other Californian species by its apical white abdominal bands. Moreover, it is unique in many ways. The larval form is marked by its relatively large, quadrate head and long, slender air tube, and by a characteristic translucent appearance, which makes it almost phantom-like in the dark, deep, woodland pools that are its breeding grounds and favorite haunts. The writer has noted them to be the sole inhabitants of such pools when the latter are covered with *Lemna* mats. Their long breathing tubes may facilitate their existance under such conditions. The females confine their blood meals to cold-blooded animals and possibly to frogs alone, these furnishing the only hosts that the writer has noted. Both males and females are attracted to human beings but, although they probe and prospect about on the exposed skin, they have never been observed to bite. The writer spent two summers in a cottage surrounded with pools containing *apicalis* larvae, yet adults were never taken in the house.

The eggs are deposited in rafts above the water level. It has always been supposed that rising water submerged these eggs and caused their hatching. Yet, after early summer, when the breeding waters are gradually declining, all stages of larvae are constantly present, which would indicate that one of two possibilities happens. The larvae may be able to hatch without wetting and fall into the water below like tabanids,[12] or, as the season grows drier, the attachment of the eggs may dry up until the eggs fall off into the water and the hatching ensues.

The species is found along the Atlantic seabord, throughout the Gulf states, and extending up the Mississippi Valley to Illinois, and on the Pacific Coast in California, where it occurs in the central valleys in wooded localities. It is not prevalent in the southern part of the State but may be far more widespread than present collections would indicate, as it is necessary to do intensive collecting or breeding work in order to secure specimens.

Subgenus **Culex** Linnaeus

The subgenus, on account of the multiplicity of subgenera that have been erected, is accurately delineated only by the characters of the male terminalia. The undivided subapical lobes, each bearing five or more appendages, the paraprocts with a tufted crown, and the phallosome with well developed processes, all unite to characterize this subgenus. The subgenus is, in turn, divided into groups, the American species falling into six groups called according to their representative species the *pipiens, territans, salinarius, tarsalis, corniger,* and *coronator* groups. The first four groups are represented in California. Of the last two groups, *corniger* is represented in the United States by the name species only, as is also *coronator*, the former occurring only in the tropics, touching this country in southern Florida, and the latter reaching into southern Texas from northern South America. With the exception of the subgenus *Neoculex*, this group represents the most northerly remnant of the genus *Culex* and, as is therefore to be expected, furnishes the majority of the representatives of this genus in temperate North America.

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[12] F. W. O'Connor (Res. Mem. London School of Trop. Med., vol. 4, London, 1923, abstract) has observed this procedure in *Aëdes pseudoscutellaris* Theob.

Group **pipiens**

This group includes *Culex pipiens* L. and *Culex quinquefasciatus* Say. It is separated from the other groups by having eight appendages on the subapical lobe of the male terminalia.

Culex (Culex) pipiens Linnaeus

Culex pipiens Linnaeus, Syst. Nat., ed. 10, p. 602, 1758.
Culex consobrinus Robineau-Desvoidy, Mem. Soc. d'Hist. Nat. Paris, vol. 3, p. 408, 1827.
Culex haematophagus Ficalbi, Bull. Soc. Entom. Ital., vol. 28, p. 287, 1893.
Culex pallens Coquillett, Proc. U. S. Nat. Mus., vol. 21, p. 303, 1898.
Culex varioannulatus Theobald, Mon. Culic., vol. 3, p. 198, 1903.
Culex azoriensis Theobald, Mon. Culic., vol. 3, p. 210, 1903.
Culex osakaensis Theobald (female), Mon. Culic., vol. 4, p. 439, 1907.
Culex comitatus Dyar and Knab, Proc. Entom. Soc. Wash., vol. 11, p. 35, 1909.
Culex quasiguiarti Theobald (female), Mon. Culic., vol. 5, p. 374, 1910.

FEMALE. *Head.* Integument brown; occiput with brownish white, narrow, curved scales on vertex, sides and ocular margins with some flat white ones; erect, forked scales on nape brown and white. Tori yellow on outer sides, deep brown within; antennae black. Palpi one-fifth as long as proboscis, black. Proboscis brownish black with some pale scales below, particularly in the middle.

Thorax. Mesonotum with brown integument, two darker, median, bare lines on anterior part; vestiture of narrow, golden brown scales uniform. Scutellum brown with pale scales and bristles. Pleurae and coxae pale brown with straw-colored scales and brown bristles. Femora metallic black above, knees and undersides white; tibiae dark above, white below; tarsi black scaled with a few pale scales below. Claws simple, 0.0-0.0-0.0. Wing scales dark brown. Length of wing 4 mm.

Abdomen. Dorsal vestiture of metallic black scales, with irregular, basal, segmental bands of white, wide in the middle, narrowed at sides where they join basal, triangular patches extending entire length of segment; last segment white scaled with median black spot. Ventral vestiture of straw-colored scales. Body length 3.5 mm.

MALE. Coloration similar to female except basal, white, abdominal bands are broad, showing little lateral constriction. Palpi exceed proboscis by length of last segment which, with next to last, is somewhat swollen and has some white scales beneath; long segment with narrow basal white band. Claw formula, 1.1-1.1-0.0.

Terminalia. Basistyles about twice as long as wide; each subapical lobe with eight appendages, beginning at apical end: a seta, a leaf, a flattened seta, two normal setae, and three rods.[18] Parameres heavily chitinized and very prominent. Median processes of phallosome long, band-like, pointed, and bent outwardly at right angles at apex of paraprocts; two processes (generally becoming the outer pair in balsam mounts) tubular, oblique, triangular in cross-section, and truncated at tip, those forming third pair pointed and oblique. Paraprocts crowned with dense tuft of stout bristles.

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[18] Although the number of appendages appears to be constant, there is a variation in the form of the spines and rods basad of the leaf.

Larva. Air tube four times as long as its width at base; pecten of nine to eleven evenly spaced teeth on basal third of tube, each tooth with four basal denticules; four hair tufts present, subapical one out of line, the two basal tufts generally six-haired, apical pair two-haired. Anal saddle ringing segment. Dorsal and ventral brushes well developed. Anal gills bluntly pointed, as long as anal segment. Comb scales of eighth abdominal segment in a triangular patch, each scale evenly fringed. Subdorsal abdominal hairs from third to sixth segment double. Mental plate roughly quadrate, apex triangular, apical tooth stouter than rest. Dorsal head hairs multiple. Antennae spinose and swollen on basal two-thirds, apical third, which is marked off by multiple hair tuft, slender, smooth with two long setae subapically inserted, apical armature of a short pedecilated digit, a long, and a short seta.

The species is not easily separated in the Californian form from *Culex quinquefasciatus* Say. In Imperial County both species occur together and careful determinations of adult females on the basis of the differentiation in the continuity of the basal bands is necessary to separate the two. Slight color variations between grayish brown and brownish gray generally offer a provisional indication. The connection of the basal bands with the lateral spots separates *pipiens* from *quinquefasciatus,* which has the lateral spots detached from the basal bands. The average variation is sufficient to make an accurate determination of the border-line specimens problematical unless supported by larval or male material. The larvae may be separated by the subdorsal tufts of the third and fourth abdominal segments, those of *pipiens* having these tufts two-haired and those of *quinquefasciatus,* single. The male terminalia differ in that *pipiens* has a pair of tubular, truncate, oblique processes, while the homologous processes of *quinquefasciatus* are upright and pointed.

It is interetsing to note that *Culex comitatus* Dyar and Knab, which represents the Californian race of *pipiens,* is identical with *Culex pallens* Coq. of Japan. The subspecies differ only in the variation of the phallosome plates of the male terminalia. Edwards (1921) has pointed out that this subspecies represents an intermediate step between *pipiens* and *quinquefasciatus* (see discussion under *Culex quinquefasciatus* Say).

This companion of man is seldom found far from human habitations, where it utilizes all available sources of water from the fresh supply of ornamental fountains to the polluted water of cesspools. It has a predilection for waters of high pollution and will even leave the vicinity of man's domiciles to breed in the fertilizing water of sewage farms. The writer once took *pipiens* larvae in pools on the floor of a little used storm sewer over one hundred and fifty yards from the entrance. It is probable that its association with man is caused by its attraction to breeding waters contaminated by sewage as it is a ferocious biter of birds, apparently preferring avian blood to that of the mammals. Under the present sanitary régime of most communities, its favorite breeding grounds are rapidly disappearing, and the species, although able to breed in purer water, is apparently on the wane. The stress that has been placed, in anti-mosquito education, on the tin can, rain barrel, and incidental water container has probably done much to hasten the diminution of this species.

It is a cosmopolitan species in temperate climates. In California, it occurs in greatest numbers in the southern part of the State, where it overlaps with *quinquefasciatus*. In the north it is apt to be taken at any point, but forms a very small percentage of the total mosquito population. In limited areas where a favorable breeding place occurs, it may become extremely numerous and constitute a veritable pest through its nocturnal biting.

Culex (Culex) quinquefasciatus Say

Culex quinquefasciatus Say, Jour. Acad. Nat. Sci. Phila., vol. 3, p. 10, 1823.

Culex pungens Wiedemann (not Robineau-Desvoidy), Auss. Zweifl. Ins., vol 1, p. 9, 1828.

Culex fatigans Wiedmann, Auss. Zweifl. Ins., vol. 1, p. 9, 1828.

Anopheles ferruginosus Wiedemann, Auss. Zweifl. Ins., vol. 1, p. 12, 1828.

Culex cubensis Bigot, Hist. Fisc. Ins. Cuba, vol. 7, p. 329, 1856.

Culex penafieli Williston, La Naturaleza, vol. 7, p. 326, 1887.

Culex skusi Giles, Gnats or Mosq., p. 292, 1900.

Culex quasipipiens Theobald, Mon. Culic., vol. 2, p. 136, 1901.

Culex fouchowensis, Theobald, Mon. Culic., vol. 2, p. 137, 1901.

Culex osakaensis Theobald (in part), Mon. Culic., vol. 4, p. 439, 1907.

Culex christopheri Theobald, Mon. Culic., vol. 4, p. 453, 1907.

Culex aikeni Dyar and Knab, Proc. U. S. Nat. Mus., vol. 35, p. 61, 1908.

Culex lachrimans Dyar and Knab, Smith. Misc. Coll. Quart., vol. 52, p. 295, 1909.

Culex revocator Dyar and Knab, Smith. Misc. Coll. Quart., vol. 52, p. 256, 1909.

Culex goughi Theobald (in part), Union S. Africa, Dept. Agr., 1st Rept. Vet. Res., p. 269, 1911.

Culex aseyehae Dyar and Knab, Ins. Ins. Mens., vol. 3, p. 112, 1915.

Female. *Head.* Integument brown; occiput with narrow, curved, brownish white scales on vertex, those on sides and along ocular margins white; many erect, forked scales, those on vertex straw-colored and those on sides black or brown. Tori yellowish on outside, brown within; antennae brownish black. Palpi short, one-fifth length of proboscis, black. Proboscis black with some white scales beneath.

Thorax. Mesonotum having a dark brown integument with two narrow, median, darker lines; vestiture of yellowish brown scales uniformly distributed. Pleurae and coxae pale brown with whitish scales and brown bristles. Femora with metallic black scales above, white beneath; knees white; tibiae black scaled, those beneath with a brownish yellow tinge. Claws simple, 0.0-0.0-0.0. Wing scales dark brown. Length of wing 4.5 mm. Halteres white with dark knobs.

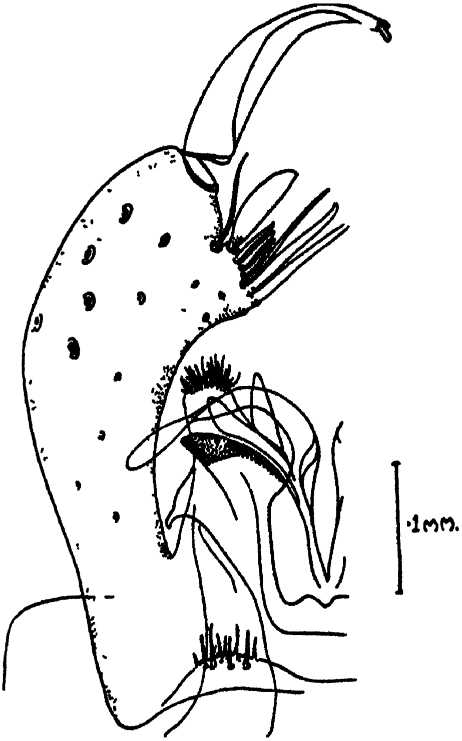

Fig. 35. *Culex quinquefasciatus* Say. Male terminalia.

Abdomen. Dorsal vestiture of black scales with basal, medianly produced, white bands, minutely separated from lateral, white, triangular patches on second to fifth abdominal segments; first segment with a median patch of white scales, sixth, seventh, and eighth segments largely white scaled. Ventral vestiture of straw-colored scales. Body length 4 mm.

Male. Coloration as in female except lateral abdominal spot linear and at right angles to basal band. Palpi exceeding proboscis by length of last segment, vestiture black with scattered white scales, last two segments with basal patches or rings of white scales. Claw formula, 1.1-1.1-0.0. Wing length 3.5 mm.; body 4.5 mm.

Terminalia (fig. 35). Basistyles a little more than twice as long as their width at base; subapical lobes quadrately produced, each bearing eight appendages; beginning at apical margin, a seta, a leaf, a flattened rod, two setae, and three rods of equal length, the first one (apical) not so stout as the other two. Phallosome with median processes leaf-like and obtusely pointed (Caifornian race), a pair of upright processes uniformly tapered to a point, and a third pair of oblique, tapered processes. Paraprocts prominent with well developed tuft of stout bristles. Lobes of ninth tergite inconspicuous, scarcely elevated, spines slender and sparse.

LARVA. Air tube four times as long as its width at base, tapered on outer half; pecten of evenly spaced teeth extending along basal third, each tooth with from two to six basal denticules. Anal saddle ringing the segment. Dorsal and ventral brushes well developed. Gills as long or longer than anal segment, stout, tapered apically. Comb scales of eighth abdominal segment numerous, forming a triangular patch, each scale narrow, apex rounded and fringed with even thorns. Subdorsal hairs of third and fourth abdominal segments single. Mental plate roughly quadrate with triangular apex, and apical tooth prominent. Dorsal head hairs multiple. Antennae with basal two-thirds swollen and spinose; a multiple hair tuft at end of swollen portion; apical third slender, tapering and smooth; apical armature of two long setae inserted subapically, a long seta, a short one, and a pedecilated digit apically.

The species is easily confused with its close relative, *Culex pipiens* L., the characteristics separating them having been pointed out in the consideration of that species. Based on the terminalia of the males of this species taken along the west coast of Mexico and in the Imperial Valley of California, Dyar and Knab have erected a "variety" which they named *dipseticus*. In this variety the leaf-like median processes are reduced in length and consequently stouter, approaching the character of these lobes in *pipiens*, which also has the terminalia modified in California. The one larval character that separates the species in this form, the singleness or doubleness of the subdorsal hairs of the third and fourth abdominal segments, is also a matter of some variation, as the writer has taken larvae with these tufts single on one side and double on the other. It would almost appear that in southern California we have a blending of the species, with resultant synthetic forms that would invalidate the separation of the species. In those parts of the world where one form or other occurs exclusively, the species appear to be well separated and authentic, but from Santa Barbara County southward and particularly in Imperial County, the variability of the individual specimens is such that a large percentage cannot be placed accurately.

Up to the present time the Imperial Valley is the only locality in California from which definite specimens of this species have been taken in numbers. In this section, although clinging to its ancestral habit of association with man wherever this is possible, it is also frankly a field breeder, utilizing roadside seepage pools or other overflowed irrigation water as its forbears of this locality undoubtedly utilized the natural flood waters before the advent of irrigation, which now facilitates breeding throughout the year. It is a vicious nocturnal bloodsucker and also sucks plant juices, which explains the "green mosquitoes" that are so often reported from the Imperial Valley.

This species is the *Culex fatigans* Wied. of European writers described in 1828. Say's description of *quinquefasciatus* (1823) is ignored by Europeans because Say's type is not certain and he refers to the vestiture of the body as "cinereous hairs," which they consider an anopheline characteristic. The distinction between the hair-like scales of *Culex* and the hairs of *Anopheles* is a rather fine point, however, for the state of culicidology in 1823. Say's added statement that the abdomen was banded and the legs shorter than in *punctipennis,* which he describes in the same paper, would exclude any anopheline and tend to fix the present species.

The species is tropicopolitan extending into the Palearctic only at scattered points but reaching into the Nearctic along the Mississippi Valley as far north as Illnois and extending laterally throughout the Gulf states. In California, well founded specimens of this species have been taken only in Imperial County, and a single male specimen from Bakersfield, Kern County (January, 1924).

Group **tarsalis**

This group is distinguished from the other groups of *Culex* (*sens. str.*) by the banded tarsi and white banded proboscis. Two of the three species present in the United States are represented in California, *tarsalis* Coq. and *stigmatosoma* Dyar; the third species, *thriambus*, has been described from central Texas by Dyar, who places it close to *stigmatosoma.*

Culex (Culex) tarsalis Coquillet

Culex tarsalis Coquillett, Canad. Entom., vol. 28, p. 43, 1896.
Culex willistoni Giles, Gnats or Mosq., p. 281, 1900.
Culex affinis Adams, Kans. Univ. Bull., vol. 20, p. 25, 1903.
Culex kelloggi Theobald, Canad. Entom., vol. 25, p. 211, 1903.
Culex peus Speiser, Insektenborse, vol. 21, p. 148, 1904.

FEMALE. *Head.* Integument black; vestiture of narrow, curved, white scales on vertex, flanked by brownish white ones on sides; ocular margins white scaled; erect, forked scales on sides black, those on nape brownish white. Tori pale brown without, black within with a patch of white scales; antennae black with white scales within on "second" segment. Palpi short, one-fifth the length of proboscis, black scales with a few white scales at apices. Proboscis black scaled, a sharply outlined white ring just before the middle.

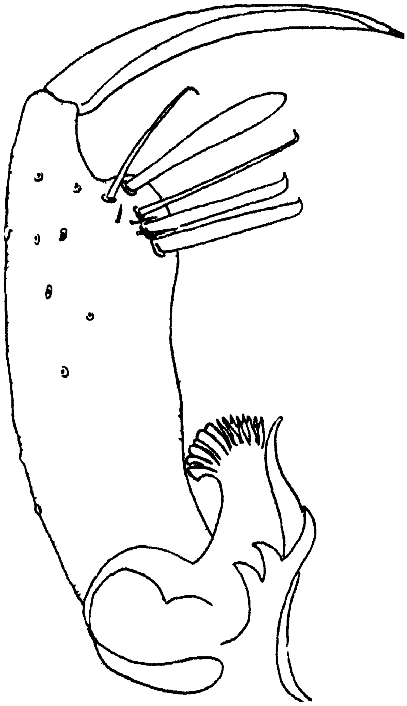

Fig. 36. *Culex tarsalis* Coq. Male terminalia.

Thorax. Mesonotum integument dark brown; vestiture of brown scales with a scattering of white ones along anterior margin and posteriorly to insertion of the wings, a few about antescutellar space and frequently forming a pair of subdorsal lines posteriorly. Scutellum brown with white scales and black bristles. Pleurae and coxae a paler brown than mesonotal integument, a few flat white scales and brown bristles. Femora black with a dotted white line, one scale wide along both sides; knees white; tibiae similar; tarsi black; hind tarsi with basal and apical white bands on all segments, last tarsal segment white; mid-tarsi with last segment brownish black; fore-tarsi with last two segments brownish black. Claws simple, -0.0-0.0-0.0. Wing scales brown with a few white scales along costa. Wing length 4.5 mm. Halteres white.

Abdomen. Dorsal vestiture of black scales with basal, segmental bands of yellowish white scales somewhat widened on sides; first segment without a band, white scales predominating in a median and two lateral patches. Ventral vestiture of straw-colored scales and an inverted V of black scales, apex of V at basal end of the segment. Body length 4 mm.

MALE. Coloration as in female except that dorsal, abdominal, basal white bands broader. Palpi longer than proboscis by length of last segment; last two segments white scaled at their bases, long segment with a subbasal white ring. Fore- and mid-tarsal claws toothed, hind ones simple, -1.1-1.1-0.0. Body length 4.5 mm.; wing length 4 mm.

Terminalia (fig. 36). Basistyles more than twice as long as their width at base; each subapical lobe generally with five appendages arranged, beginning at apical end, as a seta, a club-like leaf, a seta, and two rods; entire lobe pilose. Phallosome with each lateral plate composed of two sword-like blades, outer one with two or three recurved hooks. Paraprocts crowned with tuft of heavy bristles, outer ones blunt and thumb-like, inner ones pointed; ventral arm recurved to form semicircle. Lobes of ninth tergite present as slight elevations with a few small spines.

LARVA. Air tube slightly more than four times as long as its width at base, uniformly tapered to apex; pecten reaching over basal third of tube of evenly spaced teeth, each tooth with three long basal denticules; hair tufts five in number decreasing in size progressively toward apex and with no tufts displaced. Comb scales of eighth abdominal segment in a triangular patch, each scale linear and evenly fringed with long thorns. Anal saddle ringing segment. Gills shorter than anal segment, pointed. Subdorsal hairs of third abdominal segment in threes, those of the fourth in fours. Mental plate roughly quadrate, apical tooth prominent, last two lateral ones on each side stoutest and remote. Antennae stout and sparsely spined with long spines on basal two-thirds; multiple hair tuft separating the smooth, tapering, apical third; apical armature of two long subapical setae and apically a long seta, a short one, and a pedecilated digit.

This species and *Culex stigmatosoma* Dyar are very closely related. They are separated in the adults by the lateral white lines along the femora and tibiae in *tarsalis,* which are absent in *stigmatosoma.* In normal specimens, the ventral abdominal black marking of *tarsalis* shows the inverted V very plainly but many have it reduced to a median black spot which is characteristic of the normal *stigmatosoma.*

The larvae differ in that the subapical tuft of the air tube is in line with the other tufts in *tarsalis,* while in the normal *stigmatosoma* this tuft is slightly out of line. The appendages of the subapical lobe of the male terminalia vary somewhat in *tarsalis* in that there may be an additional seta present between the leaf and the three rods, but this is generally absent leaving but five appendages. The outer projections of the crests of the paraprocts are flat and thumb-like, those of *stigmatosoma* being uniformly pointed. The white lateral lines of the tibiae and femora may be continuous but are generally sketchy, forming a dotted line.

This mosquito is probably the most widespread of all the mosquitoes in California, occurring in fully ninety per cent of the collections made in the State and generally in quantities. It is a facultative breeder and may be found breeding in almost any ground pool, favoring those supplied with sunlight and those of fairly permanent nature, although it may be taken in deep, shady, woodland pools or in hoofprints, with *Anopheles maculipennis* Meig. They breed rapidly throughout the summer months from April to October, utilizing, during the latter part of the season, those pools of stagnant water that have become too foul for other species. Its eggs are deposited in fusiform concave rafts of varying size although usually large. The larvae are robust and may be distinguished at sight from all other Californian larvae except *stigmatosoma* by the striped appearance of the abdomen, the fourth abdominal segment appearing almost translucent, and the other alternating segments taking on a paler coloration. They generally feed suspended between the surface and the bottom, traveling horizontally back and forth across the pool and up to the surface for air, and seldom seeking the bottom unless frightened.

The adults are never conspicuous as biters of human beings in spite of their numbers and their habit of entering dwellings when opportunity offers. The presence of avian corpuscles in a number of females freshly dissected strengthens the belief that they normally confine their feeding to birds.

The species finds its greatest development on the Pacific Coast, where it is abundant from the west coast of Mexico to British Columbia. It extends eastward in diminishing numbers as far as Illinois. In California it occurs almost everywhere, even up to an elevation of over 7000 feet (Merced Lake, Yosemite National Park, June, 1921).

Culex (Culex) stigmatosoma Dyar

Culex stigmatosoma Dyar, Proc. U. S. Nat. Mus., vol. 32, p. 123, 1907.
Culex eumimetes Dyar and Knab, Proc. U. S. Nat. Mus., vol. 35, p. 61, 1908.

FEMALE. *Head.* Integument black; vestiture of pale brownish, narrow, curved scales on vertex, ocular margins white and sides of head with flat white scales; nape with erect, forked, pale brown scales. Palpi short, one-fifth length of proboscis, black scaled, apices with some white scales. Tori light brown without, with white scales on black integument within; antennae black, the "second" segment with a patch of white scales within. Proboscis black scaled with concrete white band at or just before the middle.

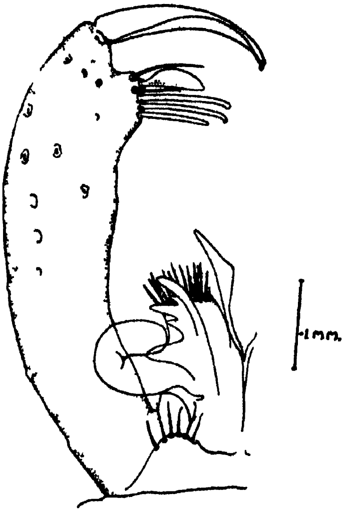

Fig. 37. *Culex stigmatosoma* Dyar. Male terminalia.

Thorax. Mesonotum with integument dark brown; vestiture of dark brown scales with a few yellowish ones along anterior and anterolateral margins and also in two indistinct, subdorsal, posterior stripes and about antescutellar space. Scutellum brown with white scales and black bristles. Pleurae and coxae pale brown with a few white flat scales and brown bristles. Femora black, white beneath nearly to apex; knees white; tibiae black, narrowly white beneath and at base and apex; tarsi black; hind tarsi with basal and apical rings on all segments; mid-tarsi with the last segment brownish black, other segments ringed as in the hind tarsi; fore-tarsi with last two segments brownish black, others ringed. Claws simple, 0.0-0.0-0.0. Wing scales brown, sometimes with white scales on costa. Length of wing 4.5 mm. Halteres white.

Abdomen. Dorsal vestiture of black scales with yellowish white ones forming a basal, segmental band widening to form row of lateral, triangular spots with constriction between band and lateral spots;

first segment black and white scaled without basal band. Ventral vestiture of straw-colored scales with oval, median, black spots, generally concrete but sometimes suffused. Body length 4 mm.

MALE. Coloration as in female except basal bands broader and lateral spots longer. Palpi longer than proboscis by length of last two segments, black with white scales at base of last two segments and a subbasal white ring on long segment. Fore- and mid-tarsal claws uniserrate, hind tarsi with claws simple, -1.1-1.1-0.0. Body length 4 mm.; wing length 3.5 mm.

Terminalia (fig. 37). Basistyles more than twice as long as their width at base; each subapical lobe generally with six appendages, arranged, beginning at apical end, as a seta, a leaf, a seta, and three rods. Phallosome erect, like *tarsalis* except outer blade of lateral plate has four hooks. Paraprocts crowned with tuft of uniform, stout, pointed bristles, basal arm recurved to form semicircle. Lobes of ninth tergite present as slight elevations with a few small spines.

LARVA. Air tube five times as long as its width at base, tapered toward apex; pecten of eleven to thirteen evenly spaced teeth, each tooth with from two to four long basal denticules, five pairs of hair tufts, basal one within pecten, subapical one slightly out of line and last one a single hair. Anal saddle ringing segment. Anal gills about as long as segment. Comb scales of eighth abdominal segment numerous in a triangular patch, each scale with narrow, pointed, basal end, apex with strong even thorns, lateral fringe of smaller ones. Subdorsal hairs of third and fourth abdominal segment in threes. Mental plate quadrate with a prominent apical tooth. Dorsal head hairs multiple. Antennae with basal two-thirds swollen, spinose; a multiple hair tuft inserted at end of swollen portions; apical third smooth and slender but not tapered; apical armature of two long setae inserted subapically, and apically a long seta, a short one, and a digit.

The four hooks of the outer blade of the phallosome of the male terminalia are not always demonstrable, the white-lined femora and tibiae of *tarsalis* are in such a condition of flux that many intergradations occur, and the ventral abdominal markings, as has already been discussed under *tarsalis*, are extremely variable. The writer has bred from a single egg mass all the variants between the concrete median spot of *stigmatosoma* and the inverted 'V' of *tarsalis*. The larvae show differences that possibly justify the separation of the species inasmuch as both breed together. The positions of the basal hair tuft of *stigmatosoma* within the pecten, the slight disalignment of its apical tuft, and the single haired condition of the apical tuft separate its larvae from those of *tarsalis*.

Its breeding habits differ from those of *tarsalis* in that it is addicted to permanent water and cannot withstand the foul conditions in which *tarsalis* larvae are often found. The larvae generally occur in fairly large pools or about the edges of ponds that are overgrown with tule, and often in the presence of great mats of duckweed (*Lemna*). The numbers are always small, probably on account of the limited number of breeding places that fulfill their requirements and the almost universal presence of fish in those favorite pools that they select.

The species is restricted to California and Oregon in the United States, although it extends down the west coast of Mexico. It finds its optimum breeding conditions in the stream ponds of dry arroyos in the southern part of California. It has been taken in small numbers throughout the central valley of California and along the coast south of Santa Barbara.

Group **territans**

Culex (Culex) territans Walker[14]

Culex territans Walker, Ins. Saund., Dipt., vol. 1, p. 428, 1856.
Culex restuans Theobald, Mon. Culic., vol. 2, p. 142, 1901.
Culex brehmei Knab, Proc. Biol. Soc. Wash., vol. 29, p. 161, 1916.

FEMALE. *Head.* Integument brown; vestiture of narrow, curved, straw-colored scales on vertex forming median stripe, lateral to these brown ones followed by flat white ones on sides and along ocular margins; nape and vertex with erect, forked, black scales; ocular bristles black. Tori pale without, inner sides black; antennae black, "second" segment pale at base. Palpi one-fifth the length of proboscis, dark brown.

Thorax. Mesonotum deep brown with a reddish tinge with two median, darker lines; vestiture of narrow, curved scales of same color with straw-colored scales along anterior and lateral margins, edges of antescutellor space, and sometimes in subdorsal paired spots. Scutellum pale brown with straw-colored scales and black bristles. Pleurae and coxae pale brown with white flat scales and pale brown bristles. Femora black except at base and narrowly to tip beneath, these parts white; tibiae black above and brownish black beneath; tarsi black except for narrow bands at bases and apices of segments of brown scales. Claws simple, 0.0-0.0-0.0. Wing scales brown, those on the costa black. Length of wing 4.5 mm.

Abdomen. Dorsal vestiture of black scales with broad, basal, segmental, white bands, that of second segment produced medianly, those of sixth and seventh widened laterally, eighth segment largely white scaled. Ventral vestiture of straw-colored scales with narrow, apical, segmental, black bands. Length of body 4 mm.

MALE. Coloration similar to female. Palpi long, exceeding length of the proboscis by length of last two segments which are black with basal patch of white scales and ventral line of white scales; long segment with subbasal white ring. Claw formula, 1.1-1.1-0.0. Body length 5 mm.; wing length 4 mm.

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[14] See footnote 11, p. 425.

Terminalia. Basistyles slightly more than twice as long as their width at base; each subapical lobe with six appendages—two setae, a leaf, and three rods with flattened tips. Phallosome has only a pair of upright pointed processes distinct, resembling those of *quinquefasciatus,* median and lateral processes not differentiated but forming a truncated cone with wide base, its apex at tip of pointed processes. Paraprocts columnar, projecting beyond phallosome and crowned with dense tuft of stout spines.

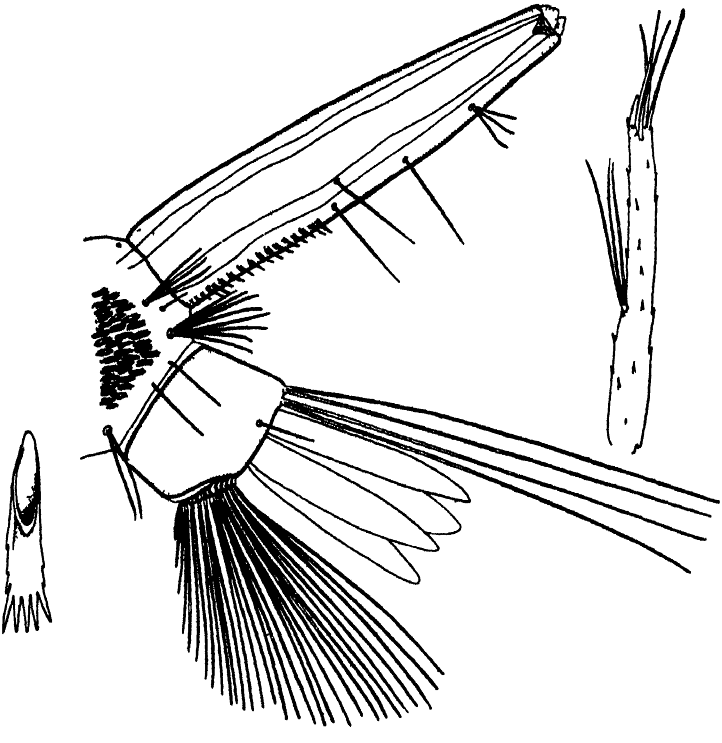

Fig. 38. *Culex territans* Walk. Caudal end of larva with enlarged comb scale at the left and antenna at the right.

LARVA (fig. 38). Air tube four times as long as its width at base, slightly tapered at both ends; pecten of evenly spaced teeth extending over basal third, each tooth rather short with three or four prominent basal denticules; hair tufts replaced by three long, single hairs and small, supapical, multiple tuft. Anal saddle ringing segment, dorsal and ventral brushes moderate. Anal gills as long or longer than anal segment, apices broadly rounded. Comb scales of eighth abdominal segment numerous in a triangular patch, each scale with spatulate tip and row of equal thorns. Subdorsal hairs of fourth and fifth segments single. Mental plate quadrate. Dorsal head hairs multiple. Antennae without a notch at insertion of hair tuft, spinose and slightly tapered for entire length; apical armature of four small spines and a pedecilated appendage.

This species has been confused frequently with *Culex pipiens* L. on account of their close relationship both in morphology and in the habits of their larvae and adults.

It has been taken but once on the Pacific Slope (Little Truckee River, May, 1921, H. G. Dyar) at a point on the eastern side of the Sierra near the Nevada line.

The species reaches its greatest development along the Atlantic seabord, but spreads westward through southern Canada and the United States to the great plains, appearing again in California with a unique capture by Dr. Dyar.

Group **salinarius**

This group contains, in addition to the name species, three other American species, *Culex similis* Theob., *Culex erythrothorax* Dyar, and *Culex badgeri* Dyar, the last two being the Californian representatives. The adults are characterized by the hair-like scales of the mesonotum. The male terminalia are characteristic and separate the group from the *pipiens* group, with which they are most liable to be confused, by having six appendages on the subapical lobe instead of eight.

Culex (Culex) erythrothorax Dyar

Culex erythrothorax Dyar, Proc. U. S. Nat. Mus., vol. 32, p. 124, 1907.

Female. *Head.* Integument yellowish brown; occiput with bright russet, narrow, curved scales on vertex flanked by straw-colored ones on sides and ocular margins and flat white ones low on sides; ocular bristles black; brown, erect, forked scales on nape. Tori light brown without, dark within; antennae black, base of "second" segment pale. Palpi very short, less than one-fifth the length of proboscis, integument reddish, scales black. Proboscis black with some pale scales beneath.

Thorax. Integument a foxy red with two median paler lines; vestiture of very narrow, hair-like, curved, golden brown scales, those about antescutellar space paler. Pleurae and coxae foxy red with narrow white scales and brown bristles. Femora metallic black above, yellow beneath; tibiae metallic black above, bronzy brown beneath; knees yellowish; tarsi like tibiae, unbanded. Claws simple, 0.0-0.0-0.0. Wing scales brown, those on costa black. Halteres white scaled, knob reddish. Length of wing 4 mm.

Abdomen. Dorsal vestiture of brownish black scales with an irregular, suffused, basal, segmental band of yellowish white scales widening at sides; first segment with mixed black and white scales. Ventral vestiture of yellowish white scales. Body length 4 mm.

Male. Coloration as in female except basal, abdominal, segmental, pale bands broader and more expanded on sides; those of apical segments reaching apex of segment; last segment all pale scaled. Palpi longer than proboscis by length of last two segments, which have patches of white scales basally and line of white scales ventrally. Claws toothed on fore- and mid-tarsi, those of hind tarsi simple, 1.1-1.1-0.0. Body length 4 mm.; wing length 3.5 mm.

Terminalia. Basistyles a little more than twice as long as their width at base, each subapical lobe with six appendages, two setae, a leaf, and three rods with flattened, recurved tips. Paraprocts with long, lateral recurved, basal arms (ventral arms of paraprocts), turning on themselves to form rough circles; numerous chitinous teeth present on processes of phallosome. Lobes of ninth tergite inconspicuous, each bearing only three or four spines.

Larva. Air tube seven times as long as its width at base, gradually tapered from base to apex; pecten of from eleven to thirteen evenly spaced teeth each with three or four rather prominent basal denticules; five pairs of hair tufts of from two to four hairs each, subapical one slightly out of line. Anal saddle ringing segment; anal gills shorter than plate and obtusely pointed. Comb scales of eighth abdominal segment with a spatulate point with fringe of even thorns. Subdorsal hairs of third and fourth abdominal segments variable, generally three or four haired. Mental plate quadrate with triangular apex, central tooth stoutest. Dorsal head hairs multiple. Antennae thickened on basal two-thirds and densely spinose; multiple hair tufts; apical third slender, unspined, tapering; apical armature of two long subapical setae, and apically a long seta, a short one, and a pedecilated digit.

Erythrothorax is most likely to be confused with *pipiens,* which sometimes has the foxy red mesonotal coloration of this species. The hair-like mesonotal scales of *erythrothorax* should separate the species easily, however. The larva with its extremely long air tube is entirely unlike any other Californian species. The length of the tube alone might confuse the species with *apicalis,* for the offset of the subapical tuft is not at all conspicuous, but the tube is regularly tapered in *erythrothorax,* while that of *apicalis* is expanded slightly at the tip.

This species is an habitué of large shallow ponds. It seldom occurs in large numbers nor is it of any particular importance, as it confines its feeding activities to birds. It breeds throughout the year in the southern part of the State, and is very rarely taken in the north although its range extends up through the central valley and northward up the coast. It has a limited range, never having been taken outside of California.

Culex (Culex) badgeri Dyar[15]

Culex federalis Dyar,[16] Ins. Ins. Mens., vol. 11, p. 186, 1923.
Culex badgeri Dyar, Ins. Ins. Mens., vol. 12, p. 125, 1924.

FEMALE. *Head.* Occiput blackish brown with narrow curved bronzy brown scales, a little lighter in color on sides; nape with upright forked scales. Proboscis uniform with brownish scales at base, becoming black distally. Palpi less than one-sixth the length of proboscis, dark brown; segments of antennae black, hairs of whorls black.

Thorax. Mesonotum brown; vestiture of very fine, narrow, curved hair-like scales, bronzy brown, indistinctly separated by longitudinal thinner scaled areas. Scutellum darker, similarly scaled, bristles long, coarse, golden brown basally and darker at tips. Postscutellum nude, pale brownish, paler on sides. Pleurae pale brown to whitish, with small patches of white scales, bristles brown. Coxae brown with small black scales, most numerous on fore-coxae; femora blackish above, brown below with fine white scales; tibiae blackish with brown line on anterior side, tip distinctly brownish white, especially on hind legs; tarsi black; claws simple, 0.0-0.0-0.0. Wing scales linear, black. Halteres whitish.

Abdomen. Dorsal vestiture black without markings, setae at ends of segments paler brown; very faint traces of basal segmental pale brownish bands, most distinctly traceable at sides, where they seem to widen; ventral vestiture pale brown. Body length 3 mm.

MALE. Coloration as in female. Palpi somewhat thickened apically, long, exceeding proboscis by combined lengths of last joint and half of penultimate joint. Antennae with last two segments long and black, the others short, pale in internodes, distinctly black ringed. Claw formula (not verified). Body length 4 mm.

Terminalia. Subapical lobes slightly prominent, each bearing six appendages, three rod-like, one slender with hooked tip, the next, leaf-like, the last, setaform. Parameres strong, conically tapered. Phallosome with sharp thumb-shaped arm basally, followed by about eight equal sharp teeth, outer limb slender and resembling teeth; process from base long, broad, and twisted at tip. Paraprocts with dense tuft of spines at tip, outer three or four stout and tooth-like; basal arm long, stout, completely recurved. Lobes of ninth tergite rudimentary, comprising a row of five setae on each side.

This species is named after Major C. K. Badger of Bakersfield, who collected the only specimens taken thus far. The larva is unknown.

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[15] This description was furnished by Dr. H. G. Dyar of the U. S. National Museum.

[16] "*Culex badgeri* Dyar may prove to be the same species as *Culex federalis* Dyar described from Mexico City; but until the life histories of both forms are known and compared, it will be better to keep the names apart."—H. G. Dyar.

SUBFAMILY ANOPHELINAE

Genus **Anopheles** Meigen

Anopheles Meigen, Syst. Beschr. Eur. Zweifl. Ins., vol. 1, p. 10, 1818.

Cycloleppteron Theobald, Mon. Culic., vol. 1, p. 205, 1901.

Cyclolepidopteron Blanchard, C. R. Soc. Biol., vol. 53, p. 1046, 1901.

Grassia Theobald (not Fisch), Jour. Trop. Med., vol. 5, p. 181, 1902.

Myzomyia Blanchard, C. R. Soc. Biol., vol. 54, p. 795, 1902.

Stethomyia Theobald, Jour. Trop. Med., vol. 5, p. 182, 1902.

Howardia Theobald (not Dalla Torre), Jour. Trop. Med., vol. 5, p. 182, 1902.

Pyretophorus Blanchard, C. R. Soc. Biol., vol. 54, p. 795, 1902.

Rossia Theobald (not Bonaparte or Owen), Jour. Trop. Med., vol. 5, p. 183, 1902.

Myzorhynchus Blanchard, C. R. Soc. Biol., vol. 54, p. 795, 1902.

Laverania Theobald (not Grassi and Feletti), Jour. Trop. Med., vol. 5, p. 183, 1902.

Nyssorhynchus Blanchard, C. R. Soc. Biol., vol. 54, p. 795, 1902.

Cellia Theobald, Jour. Trop. Med., vol. 5, p. 183, 1902.

Arribalzagia Theobald, Mon. Culic., vol. 3, p. 81, 1903.

Aldrichia Theobald, Mon. Culic., vol. 3, p. 353, 1903.

Lophoscelomyia Theobald, Entom., vol. 37, p. 12, 1904.

Lophomyia Giles, Jour. Trop. Med., vol. 7, p. 366, 1904.

Kerteszia Theobald, Ann. Mus. Nat. Hung., vol. 53, p. 66, 1905.

Nototricha Coquillett, U. S. Dept. Agr., Bur. Entom. Tech. Ser., vol. 11, p. 13, 1906.

Coelodiazesis Dyar and Knab, Jour. New York Entom. Soc., vol. 14, p. 177, 1906.

Feltinella Theobald, Mon. Culic., vol. 4, p. 56, 1907.

Myzorhynchella Theobald, Mon. Culic., vol. 4, p. 78, 1907.

Manguinhosia Cruz, Um. Nov. Gen. Braz. s.-f. Anoph., 1907.

Neocellia Rothwell, Entom., vol. 40, p. 34, 1907.

Neocellia Theobald (not Rothwell), Mon. Culic., vol. 4, p. 111, 1907.

Pseudomyzomyia Theobald, Mon. Culic., vol. 4, Suppl., 1907.

Calvertia Ludlow (not Warren), Canad. Entom., vol. 41, p. 22, 1909.

Calvertina Ludlow, Canad. Entom., vol. 41, p. 234, 1909.

Neomyzomyia Theobald, Mon. Culic., vol. 5, p. 29, 1910.

Aldrichinella Theobald, Mon. Culic., vol. 5, p. 77, 1910.

Christophersia James, Paludism, vol. 1, p. 33, 1910.

Nyssomyzomyia James, Paludism, vol. 1, p. 37, 1910.

Neostethopheles James, Rec. Ind. Mus., vol. 4, p. 98, 1910.

Patagiamyia James, Rec. Ind. Mus., vol. 4, p. 98, 1910.

Dactylomyia Newstead and Carter, Ann. Trop. Med. and Par., vol. 4, p. 377, 1910.

Proterorhynchus Brethes, Bol. Inst. Entom. y Pat. Veg., vol. 1, p. 14, 1912.

Cyclophorus Eysell, Arch. f. Schiffs.- u. Trop. Hyg., vol. 16, p. 421, 1912.

Dendropaedium Dyar and Knab, Ins. Ins. Mens., vol. 6, p. 141, 1918.

The genus was erected on the basis of the long palpi in both male and female and later augmented by the non-sexual character of the unlobed condition of the scutellum. On the basis of scale characters, a great many genera were erected but were soon abandoned. The long female palpi, the collar-like scutellum, and the hairy abdomen immediately separate the genus from all other Californian species. There are no pulvilli, nor spiracular bristles, the female abdomen is blunt and truncate, the cerci stout and broad, and the eighth segment non-retractile.

The male terminalia are distinctive in that both apical and basal lobes (as these are understood in *Aëdes*) are absent, and in the Californian species a parabasal lobe situated on the dorsal surface of the basistyles on their median line at the base bears two stout, subequal spines; the claspettes are represented by small, basal, inner lobes, single or with two or three lobes bearing stout spines. The phallosome is always very slender, rod-like, generally with a rim of "leaflets" (absent in *pseudopunctipennis*).

The larvae are distinguished by the short, sessile air tube located on the eighth segment and comprising the ninth segment (Christophers, 1922). The presence of narrow, basal, chitinous stripes dorsally on the abdominal segments; the quadrate head much narrower than the thorax; the dorsal head hairs of single branched hairs arranged in a line between the antennae; and the presence of paired palmate hairs on the abdominal segments all serve to differentiate the larvae.

The eggs of anophelines have been considered in detail by Edwards (1921) and by Herms and Freeborn (1920).

The anophelines are considered by many to be the most primitive of the true mosquitoes because of the lack of a well developed air tube in the larvae, the long palpi of the female, and the supposedly simple condition of the male terminalia. On the other hand, many factors are present that point to a wide divergence from the generalized type, which demonstrates an evolution fully as specialized as that of those groups supposed to be highly developed. The larva, although lacking the long air tube, has developed the equally efficient abdominal palmate hairs, which sustain it at the surface. The genus has evolved so far from its flower-feeding ancestors that mammalian blood is essential for the production of each batch of eggs. Some of the so-called specialized groups are still able to produce eggs on a carbohydrate diet, and other intermediate forms can oviposit two or three batches of eggs on a single blood meal. The male terminalia, although remaining comparatively simple in structure, have developed homologues of the basal lobe and claspette of *Aëdes*, which is considered to be a comparatively specialized group. The anophelines represent a group of mosquitoes that has evolved from the primitive type along lines rather widely divergent from those of the other specialized groups.

The three Californian anophelines have all been shown by laboratory experiments to be carriers of some form of malaria. *Anopheles maculipennis* Meig., the commonest and most potent malaria carrier in California, transmits tertian, subtertian, and quartan malaria. It is the orignal species used by Grassi and his coworkers under the name of *Anopheles claviger* (Fab.) for the first experimental transmissions of malaria. *Anopheles punctipennis* (Say) was shown to transmit tertian malaria by King in 1916. Hirshberg (1904) and Mintzmain (1916) have both shown that it cannot act as a host for subtertian malaria.

Darling is the only worker who has attempted to infect *Anopheles pseudopunctipennis* Theob. He was successful in infecting four specimens in twenty-seven trials with subtertian parasites, none in four trials with tertian, and a single trial with quartan was also negative.

For detailed discussion of the distribution of anophelines in California see Herms (1919 and 1920).

KEY TO ANOPHELINE MOSQUITOES OF CALIFORNIA

Adults

1. Wings with white or yellow spots on the costa 2
   Wings without such spots .... **maculipennis** Meig.
2. Palpi banded .... **pseudopunctipennis** Theob.
   Palpi unbanded .... **punctipennis** (Say.)

Larvae

1. Outer anterior clypeal hair unbranched .... **pseudopunctipennis** Theob.
   Outer anterior clypeal hair dichotomously branched 2
2. Lateral plate of eighth abdominal segment with 17 to 22 teeth, 6 or 7 of which are longer than the rest .... **punctipennis** (Say.)
   Lateral plate of eighth abdominal segment with 22 to 29 teeth, 8 or 9 of which are longer than the rest .... **maculipennis** Meig.

Male Terminalia

1. Phallosome with leaflets at the tip 2
   Phallosome without leaflets at the tip .... **pseudopunctipennis** Theob.
2. Claspette lobe abruptly conical .... **punctipennis** (Say.)
   Claspette lobe rounded .... **maculipennis** Meig.

Anopheles (Anopheles) maculipennis Meigen

Culex claviger Fabricius[17] (nec Meigen), Syst. Antl., p. 35, 1805.
Anopheles maculipennis Meigen, Syst. Beschr. Zweifl. Ins., vol. 1, p. 11, 1818.
Anopheles occidentalis Dyar and Knab, Proc. Biol. Soc. Wash., vol. 19, p. 159, 1906.
Anopheles lewisi Ludlow, Psyche, vol. 27, p. 74, 1920.
Anopheles selengensis Ludlow, Psyche, vol. 27, p. 77, 1920.

FEMALE. *Head.* Integument dark brown; vertex clothed with erect, forked scales with some erect, unforked, triangular ones, blackish except on vertex in front where they are white; ocular bristles black with clump of pale ones between eyes. ·Tori uniformly brown; antennae brownish black. Palpi about as long as proboscis, uniformly dark brown. Proboscis dark brown.

Thorax. Mesonotum long and narrow, integument pale brown with a white bloom covering antescutellar space and extending forward, sometimes as broad median stripe bisected by narrow median groove, but more often as three narrow stripes, central one with narrow, median dark groove, sides dark brown; vestiture of very minute, gray scales, coinciding with the three longitudinal stripes although occurring over wider area. Scutellum without lobes, pale brown with black bristles in a row along posterior margin. Pleurae brown. Coxae pale; femora, tibiae, and tarsi uniformly dark brown with tips of femora and tibiae with a few yellowish scales. Claws simple, 0.0-0.0-0.0. Wing scales brown and black, the latter color occurring on the longer scales and forming distinct dark spots at junction of first and second longitudinal veins, at forks of second and fourth, and at the crossveins; wing fringe uniformly grayish brown except for indistinct spot of coppery scales at tip of wing. Length of wing 5.0 mm. Halteres grayish with a black knob.

Abdomen. Brownish black, apices of segments dorsally darker than bases, densely hairy.

MALE. Coloration similar to female although generally paler, markings less distinct, abdomen very hairy. Palpi as long as proboscis, terminal and penultimate segments swollen, uniformly brownish black. Single claw of fore-tarsi toothed, the others simple, -.2-0.0-0.0. Length of body 5.5 mm.; wing 4.5 mm.

Terminalia (figs. 4, 39). Basistyles slightly less than twice as long as width at base; dististyles constricted slightly just beyond the middle; subapical lobes absent but with a long spine directed inwardly just beyond middle of basistyle; parabasal lobes on ·dorsal side of basistyles with smaller prominences at bases bearing a short and a long stout spine respectively—the parabasal spines; at base of basistyles inwardly two small, rounded claspette lobes each bearing two stout and one slender bristle, all pointed. Phallosome slender, cylindrical, with an apical opening surrounded with six leaflets. Parameres not recognizable as chitinous plates although outlines of penis cavity distinct.

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[17] The specific name *claviger* is a homonym. *Culex claviger* Meig., 1804 (which antedates *Culex claviger* Fabr., 1805) is a synonym of *Anopheles bifurcatus* (L.).

LARVA. Air tube rudimentary with only apical portions of culicine tube represented, spiracular openings remote, anterior point of median lobe small, although median lobe itself has projection into tube cavity; lateral plate of eighth abdominal segment composed of series of twenty-two to twenty-nine teeth. Anal saddle small, covering little more than top of segment, a single hair laterally below saddle; dorsal brush of two branched hairs, ventral brush well developed. Third to seventh abdominal segments with a pair of palmate hair tufts, elements of which not produced apically but ending in short point. Abdominal segments with dorsal, basal, chitinous plaques, narrow anteriorly but progressively wider posteriorly to eighth segment where its position is used by air tube, and absent on the anal segment. Mental plate small and inconspicuous with only nine teeth of varying sizes.

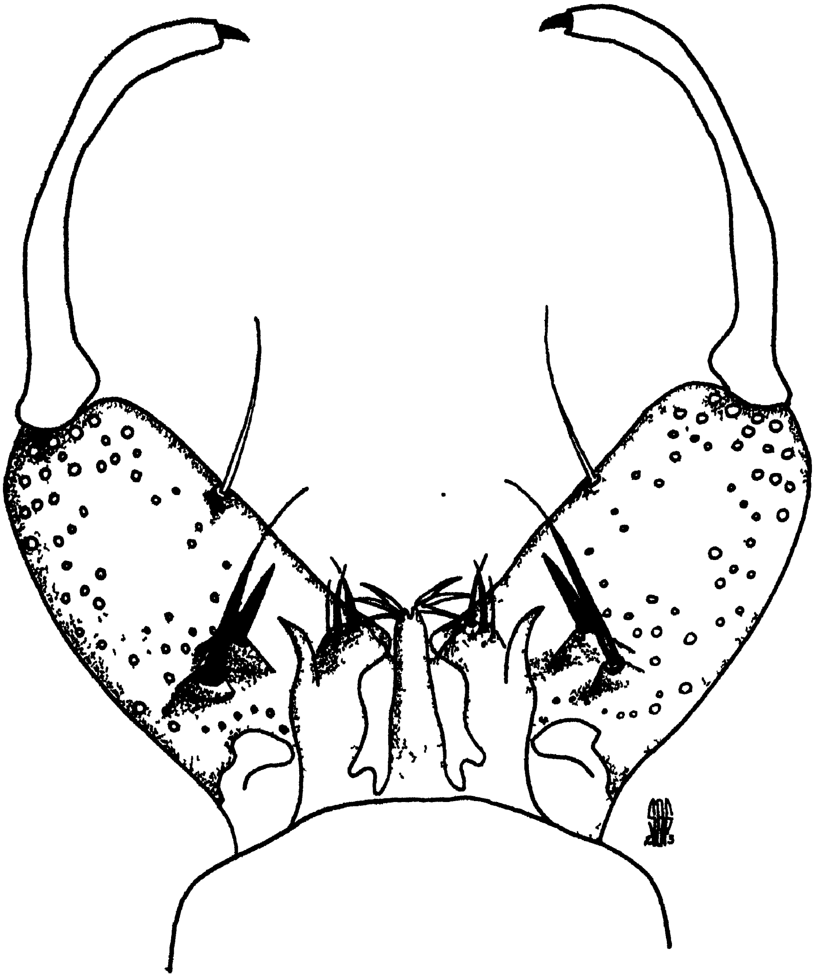

Fig 39. *Anopheles maculipennis* Meig. Male terminalia

Outer anteror clypeal hairs dichotomously branched, dorsal head hairs arranged in transverse line of single, numerously branched hairs. Antennae slightly swollen at base, a multiple hair tuft before the middle, whole shaft spined with delicate spines except basally within; apical armature of two very stout, long setae heavly chitinized, two short bract-like ones, and one long, slender, branched hair.

The generic characters and the black spotting of the wings separate the adults from all other Californian mosquitoes. It is extremely close to the eastern *Anopheles quadrimaculatus* Say, however, which is separated with certainty by larval and terminalian characters only. The distinctive coppery spot on the wing fringe at the tip is very plain in specimens taken along the moist coastal strip, but in the central valleys and the foothills of the Sierra the spot is almost always impossible to distinguish although the larval and terminalian characters of *maculipennis* persist. The larvae lack the palmate hairs on the second abdominal segment that are present in *quadrimaculatus,* and the claspette lobes of the male terminalia are subconical and have all the setae pointed, whereas those of *quadrimaculatus* are distinctly rounded and one pair of the setae is rod-like, fused and with blunt tips.

Anopheles maculipennis Meig. is the four-spotted anopheline of Europe and Canada, extending into the United States along the Pacific slope, at points along the northern boundary, and in New England.

This species is the most dangerous malaria carrier in California. It chooses shallow, sunlit pools of clear water for its breeding places, preferring those containing mats of green algae. Hoofprints, wayside pools, neglected irrigation or drainage ditches, and seepage areas furnish the most favorable locations. The species passes the winter as adult females. There is no true hibernation, as the females bite throughout the period, but no oviposition takes place until after the spring migratory flight. During February all the overwintering females issue from their hiding places, generally in or about dwellings, and become dispersed over and beyond their natural breeding limits. At this time they bite fiercely by day or night, following which they oviposit and disappear very rapidly. The species is represented, apparently, by the egg and larval stages alone from March 15 until April 20 to 25. The annual appearance of males at about this latter date marks the emergence of the first spring brood. The eggs of this brood produce the nucleus which is responsible for the vast numbers which reach their peak during the last week in September. After this date the numbers dwindle rapidly and by November 15 to 20 all the males have disappeared and only the overwintering females destined to carry the species through the winter remain.

In midsummer the larvae require from seventeen to twenty-threee days to develop from egg to adult, a much longer time than is usually stated. The writer, however, has reared several lots of larvae from egg to adult in natural surroundings without obtaining emergences at any earlier dates. It is of interest to note that, under as nearly natural conditions as it was possible to produce, the average survival from batches of from 180 to 230 eggs (the normal deposition is about 200 per oviposition) was from eight to ten imagines, generally equally divided between the two sexes.

The females of this species are addicted to man-made shelters, particularly dwelling houses. The smallest break in a screen is located with accuracy, through chimney flues to fireplaces are frequent modes of entrance and even drain pipes that open to the exterior are not disdained.

The species is Holarctic, extending throughout Europe, the Mediterranean basin, northern Asia, Alaska, Canada, and occurring in the United States in Washington, Oregon, California, at various points along the northern tier of states, and extending down the Atlantic coast as far as Massachusetts (Leverett, Mass., Oct. 8, 1923, S. B. Freeborn). In California, the species occurs practically everywhere except in the desert areas and along the Sierra crest. Warm valleys of the Sierra which have an easterly exposure to the Nevada plateau have been invaded also, as foci occur at as high an elevation as Sierraville, Plumas County (5438 feet). With the exception of these warm valleys it is unusual to take the species above the lower line of the digger pines (*Pinus Sabiniana* Dougl.). It is the predominating mosquito of the central valleys, occurs sparsely along the coast, and is extremely abundant in limited foci south of the Tehachapi.

Anopheles (Anopheles) punctipennis (Say)

Culex punctipennis Say, Jour. Acad. Nat. Sci. Phila., vol. 3, p. 9, 1823.

Anopheles punctipennis Say, Keatings Nar. Exped. St. Peter's River, vol. 2, p. 357, 1824.

Anopheles perplexens Ludlow, Canad. Entom., vol. 39, p. 267, 1907.

Female. *Head.* Integument dark brown; vestiture of erect, triangular, and some forked scales, yellowish white on vertex, black on nape and sides; ocular bristles black, those between eyes pale. Tori dark brown at base, paler around apical depression; antennae black. Palpi as long as proboscis, dark brown. Proboscis black, labella pale.

Thorax. Mesonotum narrow, dark brown with a central stripe of whitish "bloom"; vestiture of very narrow, straw-colored scales, sparse except at anterior margin. Scutellum without lobes, grayish brown with a white "bloom," a row of black bristles along margin. Pleurae mottled, general color a pale brown with darker areas and areas covered with white bloom. Coxae paler, rest of leg segments uniformly dark brown except for narrowly yellow tips of femora and tibiae. Claws simple, 0.0-0.0-0.0. Wings with black and yellow scales, the latter forming two spots on costal margin, one of which is long and situated beyond the middle, the second smaller and near apex, both spots involving costa and the two underlying veins, smaller, less distinctive spots, giving mottled appearance to wings, appear on each fork of second and fourth veins, the latter with two spots on its stem and the sixth vein white scaled except at each end. Length of wing 4.5 mm. Halteres whitish, the knobs dark.

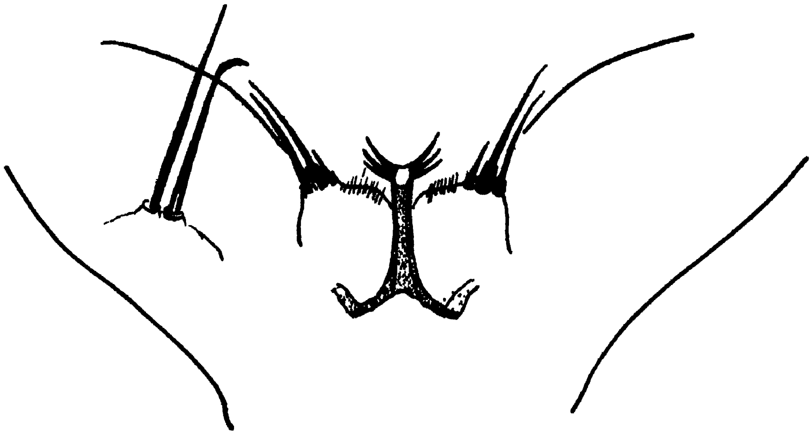

Fig. 40. *Anopheles punctipennis* (Say.). Details of genitalia showing the phallosome in the center, the claspette lobes on either side, and, on the extreme left, the parabasal spines.

Abdomen. Dark brown, apices of segments dorsally darker than bases, many fine, pale brown hairs. Length of body 5.0 mm.

MALE. Coloration similar to female except general markings paler and vestiture sparser. Single claw of fore-tarsi biserrate, the others simple, -.2-0.0-0.0. Length of body 5 mm.; wing 4.5 mm.

Terminalia (fig. 40). Basistyles less than twice as long as width at base, a spine projecting inwardly beyond the middle; dististyles slightly constricted at the middle; parabasal lobes with two stout, subequal spines; claspettes present as conical lobes each bearing at its apex two stout spines and one slender, very much shorter one, all pointed. Phallosome a slender cylinder with an apical opening fringed with six "leaflets."

LARVA. Identical with that of *maculipennis* except that lateral plate of eighth abdominal segment has seventeen to twenty-two serrations, six or seven being long, corresponding plates in *maculi-*

pennis having more than twenty-two serrations, eight or nine being long. Howard, Dyar, and Knab in the Monograph (in text and keys) state that *punctipennis* has six pairs of palmate hairs beginning on the second abdominal segment. To this Root (1922) subscribed, but Matheson and Shannon (1923) have pointed out that *punctipennis* has but five pairs of these hairs (as figured in the drawing of the larva in the Monograph of Howard, Dyar, and Knab), which the writer is able to confirm.

The presence of yellow spots on the wings and unbanded palpi separate this species from all other Californian anophelines.

The breeding pools of this species are to be found in tangled, wooded sections. They prefer cool, clear, shaded pools that have a limited exposure to sunlight.

The winter is evidently passed in the adult female stage. There is little positive evidence on this point as the hibernating quarters are probably in hollow tree trunks and other secluded places away from man's habitations. Limited numbers of the hiberating females have been taken, however, and this, with the absence of winter males and fruitless searches for overwintering larvae, is the basis for believing that the species normally passes the winter as adult females. Hibernation, as indicated by the latest seasonal collection of males, evidently begins in the central valleys during the latter part of November, although it prabably starts much earlier in the foothill sections. The appearance of the first spring brood occurs during the latter part of April in the central valleys.

The females seldom enter dwellings and are only rarely taken in stables or outhouses but are frequent biters in the open or on unscreened porches.

The species is found in all sections of the United States except the arid west, extending south to Mexico and reachng northward into Canada on both coasts. In California, it is rarely taken south of the Tehachapi but is the predominating anopheline of the foothill sections, occurring in greatest numbers along the Mother Lode line. It is also the predominating anopheline in limited foci along the Sacramento River where wooded sections offer breeding places.

Anopheles (Proterorhyncus) pseudopunctipennis Theob.

Anopheles pseudopunctipennis Theobald, Mon. Culic., vol. 2, p. 305, 1901.
Anopheles franciscanus McCracken, Entom. News., vol. 15, p. 12, 1904.
Anopheles peruvianus Tamayo and Garcia, Los Ag. de Huac., Mem. Munc. Lima, App., p. 35, 1907.
Proterorhynchus argentinus Brethes, Bol. Inst. Entom. y Pat. Veg., vol. 1, p. 15, 1912.
Anopheles tucumanus Lahille, An. Mus. Nac. Hist. Nat. Buenos Aires, vol. 23, p. 253, 1912.

Female. *Head.* Integument dark brown; occiput with a dense vestiture of upright, triangular scales, those on vertex white, at sides blackish; ocular bristles black, those between eyes white. Tori dark brown basally, edges of apical depression paler; antennae black. Palpi as long as proboscis, black scaled with white rings at the middle of long segment, base and apex of fourth and the last segment entirely white. Proboscis black.

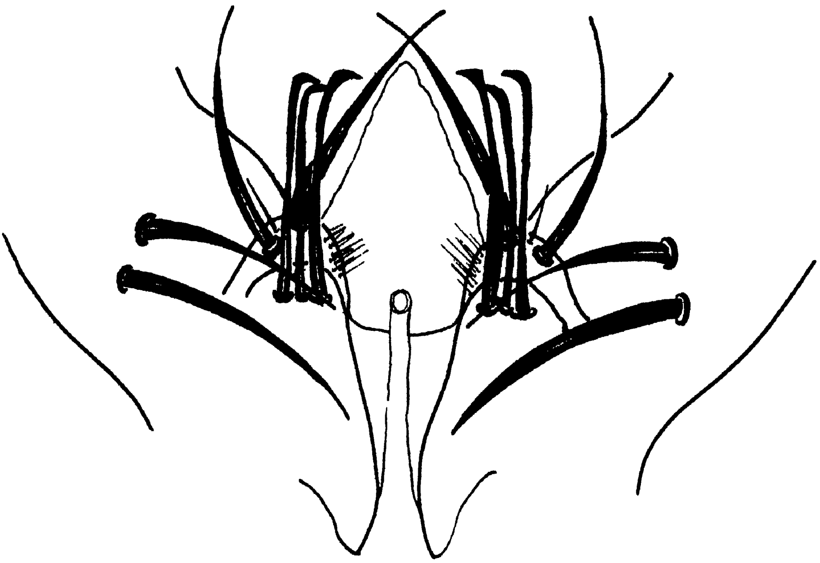

Fig. 41. *Anopheles pseudopunctipennis* Theob. Details of genitalia showing unarmed phallosome in the center, the bilobed claspette lobes on either side, and the double parabasal spines.

Thorax. Mesonotum narrow, sides dark brown, a median broad stripe of pale brown with a whitish bloom; vestiture of small, straw-colored scales and smaller white ones, the latter predominating in the middle anteriorly. Scutellum without lobes, pale brown with a row of brown setae along margin. Pleurae dark brown. Coxae pale brown; femora, tibiae and tarsi uniformly brownish black except that tips of femora and tibiae narrowly yellow scaled. Claws simple, 0.0-0.0-0.0. Wing scales black and pale yellow, the yellow appearing in long spot beyond the middle of costa, which involves costa, tip of Sc, and R_{2+3} but not R_{4+5}, again near apex and involving costa, tip of R_{2+3} and R_{4+5}, and with yellow spots on wing fringe at apex; Sc with one spot and R with two before the middle, none of which involving costa; media largely black scaled; cubitus pale scaled to fork except one black spot; Cu_1 black scaled except for pale spot at its middle point; Cu_2 pale at base and with dark scales distally; anal vein pale scaled basally but with hair-like dark scales distally; wing fringe with alternating stripes of black and pale scales. Wing length 4.5 mm. Halteres pale, knobs dark.

Abdomen. Brownish black with many pale brown hairs. Length of body 5.0 mm.

MALE. Coloration similar to female except abdominal segments paler at bases with medium dark spots in pale basal portion. Wings with markings indistinct. Palpi with last two segments swollen and pale scaled, base of last segment and apex of penultimate narrowly black, long segment dark scaled with a pale ring at the middle. Single claw of fore-tarsi biserrate, others simple, -.2-0.0-0.0.

Terminalia (fig. 41). Basistyles a little less than twice as long as width at base; dististyles slightly constricted in the middle; a long differentiated spine beyond the middle of basistyle inwardly; parabasal lobes with two very stout, subequal spines; claspette lobes bilobed, ventral lobe dome-like with two stout setae and a slender one between, dorsal lobe conical with three strong setae, the tips being expanded and flattened, a smaller straight spine at base of this lobe. Phallosome simple, cylindrical, an apical opening without "leaflets." Root (1924) has noted the presence of four, delicate, serrate "leaflets" on specimens from Tampico, Mexico.

LARVA. As in *maculipennis* except antennae densely spined, leaves of palmate hairs drawn out in a long, apical point, and outer anterior clypeal hairs unbranched.

This species has the appearance in the adult stage of an indistinct specimen of *punctipennis*, from which it is easily separated, however, by the banding of its palpi. The wing markings are distinctive also, in that the fringe is variegated and the extensive white scaling at the base of the first vein leaves the narrow black line of the costa above this section distinct.

Under laboratory conditions, this species has been shown to be a carrier of malaria. It breeds in wayside, sunlit pools in company with *Anopheles maculipennis* Meig. and continues to breed for some time after the pools have become too foul for the latter. It seldom enters human habitations, resembling *Anopheles punctipennis* (Say) in this respect as well as in its seasonal life history.

It has an exceptionally wide range through the Neotropical, extending from central South America northward along both coasts, invading the Southwest, and extending farthest north in the Sacramento Valley in California. It has been recorded from Oregon, but the specimens have been lost and the record appears rather doubtful to the writer as its northernmost occurrence in California does not coincide with any barrier save that of latitude. In California, the species occurs southward along the coast from Sonoma County, and throughout the central valleys southward from Red Bluff, Tehama County, reaching into the foothills of the San Joaquin and becoming the most abundant anopheline south of the Tehachapi.

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